

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

STH

United States
Department of
Agriculture

December 1988

60
5

1988 Report on USDA Human Nutrition Research and Education Activities

A Report to Congress

PREFACE

This report was prepared under the auspices of the USDA's Subcommittee for Human Nutrition, Research and Education Committee of the Secretary of Agriculture's Policy and Coordination Council.

USDA Agency representatives who assisted in preparing this report were Gerald F. Combs, Agricultural Research Service; Marcia Gibney, Agricultural Marketing Service; Judith Putnam, Economic Research Service; Melody Bacha, Food and Nutrition Service; William Carlson, Competitive Research Grants, Office of Grants and Program Systems; George Mountney, Cooperative State Research Service; Jim Krebs-Smith, Food and Nutrition Information Center, National Agricultural Library; Stan Prochaska, Office of Information, Office of Governmental and Public Affairs; Alanna Moshfegh, Human Nutrition Information Service; Paul R. Crowley, Office of International Cooperation and Development; Marge Stanton, Higher Education Programs, Office of Grants and Program Systems; Milton Baldauf, Extension Service; Linda Posati, Food Safety and Inspection Service; and Suzanne Harris, Food and Consumer Services. Lorraine Walsh typed the report.

Copies of this report can be obtained from Gerald F. Combs, Chairperson, USDA, Subcommittee for Human Nutrition, Room 132, Building 005, BARC-West, Beltsville, Maryland.

Agency Abbreviations

<u>Agency</u>	<u>Agency Abbreviation</u>
Agricultural Marketing Service	AMS
Agricultural Research Service	ARS
Agricultural Stabilization and Conservation Service	ASCS
Cooperative State Research Service	CSRS
Competitive Research Grants Office	CRGO
Economic Research Service	ERS
Extension Service	ES
Food and Nutrition Service	FNS
Food Safety and Inspection Service	FSIS
Human Nutrition Information Service	HNIS
National Agricultural Library	NAL
Office of Governmental and Public Affairs	OGPA
Office of Grants and Program Systems	OGPS
Office of International Cooperation and Development	OICD

CONTENTS

<u>EXECUTIVE SUMMARY</u>	1
I. <u>INTRODUCTION</u>	
A. Charge.....	1
B. Legislative.....	1
C. Changes in Resources or Infrastructure.....	2
II. <u>HUMAN NUTRITION RESEARCH ACTIVITIES</u>	3
A. Normal Requirements for Nutrients.....	5
B. Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders.....	16
C. Food Composition and Nutrient Bioavailability.....	21
D. Food and Nutrition Monitoring Research.....	29
E. Food and Nutrition Information and Education Research.....	39
F. Research on Government Policies and Socioeconomic Factors.....	41
III. <u>NUTRITION EDUCATION AND INFORMATION PROGRAMS</u>	
A. USDA's Responsibility That the Federal Government "Speaks With One Voice" When Issuing Dietary Guidance.....	43
B. Programs Initiated or Expanded.....	45
IV. <u>FUNDING LEVELS</u>	52
V. <u>COORDINATION AND ADVISORY MECHANISMS</u>	
A. Coordination Within the Federal Sector.....	58
B. Coordination Within USDA.....	61
C. Coordination With the Private Sector.....	64
D. Advisory Groups.....	65

EXECUTIVE SUMMARY

Introduction

In accordance with the provisions of section 1452(a) of the National Agricultural Research, Extension and Teaching Policy Act Amendments of 1985 (7 U.S.C. 3173 note) this report on the human nutrition research and education activities of the Department of Agriculture for FY 1988 is hereby submitted. Emphasis is placed on directions and highlights with no effort made to restate the Department's detailed plan, which was outlined in a report submitted in 1986.

Contents of Report

New human nutrition research projects initiated and research highlights during FY 1988 are presented for USDA agencies by six research areas:

- o Normal Requirements for Nutrients
- o Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders
- o Food Composition and Nutrient Bioavailability
- o Food and Nutrition Monitoring Research
- o Food and Nutrition Information and Education Research
- o Research on Government Policies and Socioeconomic Factors

The Food and Nutrition Information and Education programs within USDA also are summarized by new initiatives and ongoing programs to meet their clients needs. During FY 1988, improved communication exchange and cooperation among agencies on information and education activities was strengthened.

Human nutrition research and education activities in USDA continued to be linked with the nutritive value of foods, human nutritional needs, the kinds and amounts of foods that Americans consume relative to their needs and strategies for improving diets and the food supply. The major role of USDA is to help individual consumers to understand the relationship of food and its nutrients to the maintenance of health and prevention of diet-related disorders during the different stages of life.

Funding Levels

The actual or estimated expenditures for human nutrition research and human nutrition information and education by the several USDA agencies for fiscal years 1984 through 1989 are given. The total amount of human nutrition research support by USDA has increased from \$53.3 million in FY 1984 to \$61.6 million in FY 1989, or an increase of 15.6 percent. During the same period, USDA support for human nutrition information and education has increased from \$128.5 million to \$146.0, an increase of 13.6 percent. Most of the funds for information and education activities were distributed to and managed by State agencies. The total USDA support for human nutrition in FY 1988 was \$202.7 million and is estimated to be \$207.6 million in FY 1989.

Coordination

Continued progress was made during FY 1988 in achieving coordination within the Department of Agriculture, with other Departments, and with the private sector, thus helping to provide the best services possible within available resources. Specific recommendations made by outside advisory groups are also included.

1988 ANNUAL REPORT ON USDA HUMAN NUTRITION RESEARCH AND EDUCATION ACTIVITIES

A REPORT TO CONGRESS

I. INTRODUCTION

A. Charge

The provisions of section 1452(a) of the National Agricultural Research, Extension and Teaching Policy Act Amendments of 1985 (7 U.S.C. 3173 note) required the Secretary of Agriculture to submit to the appropriate committees of Congress by December 28, 1986, a comprehensive plan for implementing a national food and human nutrition research program, including recommendations relating to research directions, educational activities, and funding levels necessary to carry out such a plan. This was done.

Section 1452(b) of the above Act requires the Secretary annually thereafter to submit a report on the human nutrition research activities conducted. Such a report, prepared under the auspices of USDA's Subcommittee for Human Nutrition, Research and Education Committee of the Secretary of Agriculture's Policy and Coordination Council, was submitted. This second report covers the Department's activities in human nutrition research and education activities for 1988. As in the last report, emphasis is given to new directions and accomplishments during the year. Again, no effort has been made to restate the detailed program plan components as described in the report submitted in 1986.

B. Legislative

1. Nutritional Guidance

Specific Program Enactments: The Human Nutrition Information Service (HNIS) has been identified in the 1988 Agriculture, Rural Development, and Related Agencies Appropriation Bill (Conference Report accompanying H.J. Res. 395) to provide the policy basis for issuing Federal nutritional guidance to the public. The Agency is directed to reestablish a Dietary Guidelines Advisory Committee in conjunction with DHHS. The Dietary Guidelines Advisory Committee is to review the scientific data relevant to nutritional guidance and make recommendations to the Secretaries on appropriate changes, if any, in the Dietary Guidelines.

2. Year 2000 Health Objectives

The House Appropriations Committee report for FY 1989 stated "the Committee will expect the Department using its human nutrition research centers, to prepare a report prior to the fiscal year 1990 appropriation hearings regarding work done thus far with respect to nutrition matters in the Year 2000 Health Objectives study conducted by the Department of Health and Human Services. The centers should review the testimony and material presented at the various public hearings regarding this study for comparison with current verifiable scientific conclusions on human nutrition. The centers should also review the methodology of preparing the final report along with the data supporting the report's recommendations."

C. Changes in Resources or Infrastructure

1. Completion of the Children's Nutrition Research Center (CNRC)
Building

The Children's Nutrition Research Center's new facility, located at Baylor College of Medicine, Houston, Texas, on land leased from the Baylor College of Medicine and the Texas Medical Center, was completed and occupied in September 1988. Dedication of the 11-story building (with a 3-level underground parking garage) was held on October 7, 1988. The building is connected by a tunnel/elevator pod with the Texas Children's Hospital. The new facility will provide 131,774 net square feet of space, over 50 percent of which will be dedicated to research activities relating to the nutritional needs of mothers and children through adolescence. It is a unique Federal facility and is extraordinarily well planned and equipped with state-of-the-art facilities.

II. HUMAN NUTRITION RESEARCH ACTIVITIES

Human nutrition research and education in USDA traditionally has been linked with the nutritive value of foods, human nutritional needs, the kinds and amounts of foods that Americans consume relative to their needs and strategies for improving diets and the food supply. It is the policy of the USDA to promote optimal health and well-being through improved nutrition. A major effort in the USDA is to understand the relationship of food and its nutrients to health promotion in healthy individuals at all stages of life.

The application of new nutritional knowledge often leads to changes in kinds and amounts of foods people consume, and hence often the demand for food. Similarly, any improvement of the nutritional quality of the foods we eat must involve corresponding changes in the agricultural food system. Hence, the nutrition of individuals or of population groups depends on a host of factors that occur in the "food chain" before food becomes available for consumption, i.e., during production, processing and storage, and marketing. To ensure an adequate supply of high quality foods, an intimate knowledge of food composition, of the biological effects of food constituents, and of nutritional requirements and tolerances of humans is needed. This knowledge can be derived only through interdisciplinary efforts, interfacing nutrition research with pre- and post-harvest agricultural science and technology.

The human nutrition research activities during FY 1988 are presented under six areas as detailed in the national plan. These are:

- o Normal Requirements for Nutrients
- o Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders
- o Food Composition and Nutrient Bioavailability
- o Food and Nutrition Monitoring Research
- o Food and Nutrition Information and Education Research
- o Research on Government Policies and Socioeconomic Factors

It is important to note that the USDA research activities also fit well into the Federal 5-Year Plan, released by the Interagency Committee on Human Nutrition Research (ICHNR) in 1986. The USDA does not conduct research on the role of nutrients in the treatment of chronic diseases or disorders. It does, however, support some research on health promotion or prevention of nutrition-related disorders, especially as related to fats, fiber, and complex carbohydrates and other components of foods and diets. The USDA program focuses especially on normal nutrient requirements and content and bioavailability of nutrients in foods.

A computer search was made on September 21, 1988, of ongoing research in USDA relating to human nutrition, using the Human Nutrition Research Information Management System (HNRIMS). Table 1 shows the number of USDA research projects in most of the nutrition code categories under each of the six research areas listed above. The table also shows the percentage of the total number of USDA projects that were coded for each of the categories. In

Table 1. USDA Research in Human Nutrition
(from HNRIMS, September 21, 1988)

<u>HNRIMS Nutrition Code Area</u>	<u>USDA Projects*</u>		<u>USDA Projects as % of Federal Research in Area</u>
	<u>Number</u>	<u>%</u>	
<u>Normal Human Requirements for Nutrients</u>			
1. Maternal	47	4.6	24
2. Infant and Child	54	5.2	15
3. Adolescent	17	1.6	21
4. Adult	69	6.7	52
5. Elderly	35	3.4	22
10. Immunology, Nutrition & Infection	12	1.2	10
12. Genetics and Nutrition	9	0.9	4
13. Nutrition and Function	114	11.1	32
14. Nutrient Interactions	130	12.6	28
<u>Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders</u>			
6. Cardiovascular Disease and Nutrition	58	5.4	11
7. Cancer	35	3.4	6
8. Other Diseases (Osteoporosis, Diabetes)	39	3.8	8
11. Obesity, Anorexia and Appetite Control	29	2.8	8
17. Carbohydrates	66	6.4	33
18. Lipids	156	15.1	27
20. Proteins and Amino Acids	116	11.3	30
21. Vitamins	108	10.5	20
22. Minerals and Trace Elements	173	16.8	37
23. Water and Electrolytes	11	1.1	9
24. Fiber	34	3.3	55
25. Other Nutrients in Foods	30	2.9	31
<u>Food Composition and Bioavailability of Nutrients</u>			
26. Food Composition	238	23.1	78
27. Bioavailability of Nutrients	118	11.4	72
28. Effects of Technology on Nutritional Characteristics of Food	299	29.0	92
29. Other Food Science Research	115	11.2	80
<u>Food and Nutrition Monitoring Research</u>			
16. Nutritional Status	143	13.9	42
30. Food Consumption Surveys	52	5.0	70
31. Dietary Practices, Food Consumption Patterns	124	12.0	40
<u>Food and Nutrition Information and Education Research</u>			
32. Methods for Informing Public About Nutrition	27	2.6	39
33. Other Nutrition Education Research	18	1.7	60
<u>Effects of Gov. Policy and Socioeconomic Factors</u>			
34. Effects of Gov. Policy and Socioeconomic Factors on Food Consumption and Nutrition	49	4.8	91

*Numbers are not additive as projects may be assigned more than one nutrition code (1,031 USDA research projects in system).

addition, the percentage of the total number of research projects in HNRIMS for all Federal agencies (as of September 21, 1988) which are USDA supported projects, by nutrition code category. The USDA projects include those conducted by the USDA agencies and the State Agricultural Experiment Stations and 1862 and 1890 land grant institutions and Tuskegee University. Some of these projects receive no Federal funds. The total Federal funds expended by USDA for human nutrition research in FY 1988 was \$60.4 million (see Table 2, Section IV).

A. Normal Requirements for Nutrients (ARS, CSRS)

1. Competitive Research Grants Program

In FY 1987, the Human Nutrient Requirements Program of the Competitive Research Grants Office (CSRS) awarded \$2,253,396 in grant support for 27 different projects in nutrition research. These projects will increase our understanding of requirements for nutrients in relation to different patterns of food intake. The findings will help fill the gaps of our knowledge about nutrient requirements, bioavailability, the interrelationships of nutrients, and the nutritive value of foods consumed in the U.S. The following projects were funded in FY 1987:

- o Neural Responses to Disproportionate Amino Acid Diets: Role of Monoamines, \$70,000, Quinton R. Rogers, University of California, Davis.
- o Nutrient Intake and Growth of Breast-Fed Infants, 3-18 Months, \$72,400, Kathryn G. Dewey, University of California, Davis.
- o Manganese Absorption in Humans, \$40,000, Bo Lonnerdal, University of California, Davis.
- o Psychocognitive Effects of Mild Zinc Deficiency in Infants, \$160,996, K. M. Hambidge, University of Colorado Health Sciences Center, Denver.
- o Is Carnitine an Essential Nutrient for the Newborn? \$42,000, Peggy L. Borum, University of Florida, Gainesville.
- o Evaluation of the Status and Requirements of Humans for Vitamin A. \$270,000, James A. Olson, Iowa State University of Science & Technology, Ames.
- o Biotin in Human Milk, \$50,000, Donald M. Mock, University of Iowa, Iowa City.
- o Resistance of Legume Proteins to Proteolysis: Role of Heat-Stable Proteinase Inhibitors, \$40,000, S. Suzanne Nielsen, Purdue Research Foundation, West Lafayette.
- o Effects of Different Types of Dietary w3 Fatty Acids on Eicosanoid Synthesis. \$60,000, Daniel H. Hwang, Louisiana State University & A&M College, Baton Rouge.
- o Vitamin C Status in Healthy Women: A Stable Isotope Approach, \$50,000, John J. Cunningham, University of Massachusetts, Amherst.

- o Choline Deficiency in Humans--Effects on Muscle Function, \$56,000, Steven H. Zeisel, Boston University.
- o Biochemical Reasons for the Requirement of Vitamin A in the Mammalian Organism. \$260,000, George Wolf, Massachusetts Inst. of Technology, Cambridge.
- o Methionine Kinetics in Relation to Methionine Requirements in Man, \$51,000, Vernon R. Young, Massachusetts Inst. of Technology, Cambridge.
- o Maternal Vitamin B-6 Nutrition: Effects on the Dopaminergic System of Progeny, \$40,000, Tomas R. Guilarte, Johns Hopkins University, Baltimore.
- o Metabolism and Function of Retinoic Acid in the Small Intestine, \$110,000, Maija H. Zile, Michigan State University, East Lansing.
- o Estimation of Daily Copper Intake, \$51,000, Gretchen M. Hill, University of Missouri, Columbia.
- o Dietary Carotenoids and the Concentrations of Vitamin A in Tissues, \$65,000, Joseph L. Napoli, State Univ. of New York, Albany.
- o Calcium Bioavailability in Dairy Foods: Validation and Application of a Method, \$70,000, Dennis D. Miller, Cornell University, Ithaca.
- o Photodegradation of Carotenoids in Vivo: Assessment of Role of Photosensitizers, \$50,000, Daphne A. Roe, Cornell University, Ithaca.
- o Nonnutritive Sweeteners and Food Intake in Man, \$86,000, Michael G. Tordoff, Monell Chemical Senses Center, Philadelphia.
- o Vitamin A and Immunity, \$70,000, A. Catharine Ross, Medical College of Pennsylvania, Philadelphia.
- o Requirements of Manganese in Women, \$80,000, J. Freeland-Graves, University of Texas, Austin.
- o Interaction of Zinc and Vitamin B-6 in Estrogen-directed Gene Expression, \$30,000, George E. Bunce, Virginia Polytechnic Institute & State Univ., Blacksburg.
- o Bioavailability and Requirements of Biotin for Infants and Children, \$50,000, Gregory S. Heard, Virginia Commonwealth Univ., Richmond.
- o Nutritional Modulation of Intestinal Vitamin Transport, \$60,000, William H. Karasov, University of Wisconsin, Madison.
- o Chloride, Calcium and Sodium Interactions, \$80,000, Janet L. Greger, University of Wisconsin, Madison.
- o Human Phylloquinone Requirement, \$189,000, John W. Suttie, University of Wisconsin, Madison.

The following grants were funded in FY 1988:

- o Effect of Vitamin B-6 Intake on Vitamin B-6 in Human Muscle, \$140,471, Stephen P. Coburn, Fort Wayne State Development Center, Indiana.

- o Vitamin A Delivery, Uptake, and Metabolism in Cultured Human Keratinocytes, \$108,602, Kim E. Creek, University of South Carolina, Clemson.
- o Alteration of Immune Development by Gestational Zinc Deprivation, \$51,324, Pamela J. Fraker, Michigan State University, East Lansing.
- o Kinetic Analysis of Vitamin A Status, Requirements and Metabolism, \$128,025, Michael H. Green, Pennsylvania State University, University Park.
- o Stable-Isotopic and Radioisotopic Investigation of Folate Bioavailability, \$175,988, Jesse F. Gregory, University of Florida, Gainesville.
- o Milk Lipases in Delivery and Digestion of Fat in Infants: An Animal Model, \$91,709, Margit Hamosh, Georgetown University Medical Center, Washington, D.C.
- o Vitamin B-6 Status and Need of Women: Effect of B-6: Protein Ratio and Bioavailability, \$191,025, James E. Leklem, Oregon State University, Corvallis.
- o Significance of Trypsin Inhibitors in the Human Diet, \$126,092, Irvin E. Liener, University of Minnesota, St. Paul.
- o Manganese Absorption in Humans, \$91,000, Bo Lonnerdal, University of California.
- o Human Urinary Catabolites of Riboflavin, \$73,775, Donald B. McCormick, Emory University, Georgia.
- o Cholesterol Effect on The Expression of Viral Genes in Atherogenesis, \$85,886, Jason C. Shih, North Carolina State University, Raleigh.
- o Metabolic Factors Affecting the Dietary Requirement for Cystein, \$89,406, Martha H. Stipanuk, Cornell University, New York.
- o Placental Ca²⁺ Transport and Ca²⁺-Binding Protein, \$203,041, Rocky S. Tuan, Jefferson University, Pennsylvania.
- o Copper Absorption: Role of Sodium and Natural Ligands, \$152,388, Raul A. Wapnir, North Shore University Hospital, New York.
- o Exchangeability and Absorption of Calcium in Humans, \$115,063, Connie M. Weaver, Purdue University, Indiana.
- o Retinol (Vitamin A) Status and Metabolism in Neonatal Lung Injury with Oxygen, \$194,601, Richard D. Zachman, University of Wisconsin, Madison.

Results from ongoing intramural and extramural research supported by USDA are given in the following sections.

2. Infants and Children

o Energy Intake and Expenditure of Infants

Data from a longitudinal study of 45 infants (birth to 9 months) continue to indicate that current recommendations for energy intakes of breast-fed infants

are too high and that their growth patterns differ from National Center for Health Statistics standards. These findings have an impact on children in the developed as well as the developing world. Energy expenditure data obtained on breast-fed infants by the dual-labeled water method support previous estimates of energy intake that were significantly (approximately 18 percent) below present recommended levels. The data suggest that despite significantly lower energy intakes, the level of energy expenditure on activity by breast-fed infants is similar to that of formula-fed infants.

- o Factors Contributing to Low Birth Weight

A study has been initiated to determine the factors associated with low birthweight among infants born of middle- and low-income mothers in Houston, Texas. These will represent Black, Hispanic, and White American populations in that area. A food frequency questionnaire was developed to obtain information on the usual food intake of the mothers, and a microcomputer program has been completed for entry and analysis of the data.

- o Human Lactoferrin Increases Thymidine Incorporation

More rapid growth occurs in the gastrointestinal tract of newborn animals when they are fed their mothers' milk rather than commercial formula. Lactoferrin, one of the major proteins in human milk, stimulates DNA synthesis which occurs during growth. Laboratory experiments have been performed using commercial formulas available for young infants with diarrhea and found that the formulas suppressed DNA synthesis. The suppression, however, was overcome to a degree by the addition of lactoferrin. Further study is required before the addition of lactoferrin to infant formulas is recommended.

- o Utilization of Glucose Polymers by Young Infants

In previous studies it was determined that in young infants, non-branched short chain starches were digested and absorbed better than non-branched long chain starches. Studies are now underway to measure the digestibility of branched rice starch as used in baby cereal. The effect of feeding the cereals on formula intake and energy balance also is being investigated. Progress has been made in the use of the infant miniature pig as an animal model in which to study the early development of digestive function in the human infant; the infant miniature pig will be useful to study mechanisms of carbohydrate digestion in more detail than can be carried out in human infants.

3. Maternal Nutrition

- o The Role of Dietary Fat in the Production of Human Milk Fat

Milk fat concentration varies significantly among women who consume diets similar in nutrient composition. Factors that influence the synthesis and secretion of milk fat are poorly understood. Synthesis of fatty acids by the mammary gland and the transport and oxidation of dietary lipids were studied in seven lactating women who received either a low-fat, high-carbohydrate diet (10% fat, 75% carbohydrate) or a high-fat, low-carbohydrate diet (40% fat, 45% carbohydrate). Endogenous mammary fat synthesis was measured using the incorporation of deuterium (heavy hydrogen) from body water into saturated fatty acids of breast milk. ¹³C-Triolein (a fat containing only monounsaturated fatty acids with a stable carbon label) was used to measure dietary lipid oxidation and secretion into milk fat. Milk fat concentration

and triolein secretion were increased, but total daily milk fat secretion was unchanged. These results suggest that the mammary gland will preserve milk fat secretion despite restricted dietary lipid intake. Previous studies have shown that about 30 percent of human milk fat is derived from dietary fat, 10 percent from endogenous mammary synthesis and 60 percent from body lipid stores in the body.

o Protein Metabolism During Lactation

Although the effects of maternal nutrient intake on milk quantity and quality have been investigated, little is known about the effect of lactation on maternal body protein metabolism. Lysine labeled with the stable isotopes nitrogen-15 and carbon-13 was administered to ten postpartum women (five of whom were breastfeeding their infants) to determine if childbirth and lactation have a significant effect on lysine and protein metabolism. The stable isotopic labeling of lysine, an essential amino acid in proteins, enables investigators to trace its metabolic pathway through the body. The rate at which lysine was incorporated into muscle protein was significantly reduced in the lactating women. The lactating group had smaller splanchnic and extracellular pools of free lysine. Lactation appeared to increase the rate constant for absorption of orally-administered lysine and to decrease the rate constant for lysine incorporation into muscle protein. The lactating group had a muscle free lysine pool characterized by a slower rate of uptake of extracellular lysine and a slower rate of protein synthesis. The effects on muscle protein metabolism imposed by hormonal changes associated with lactation are still to be examined.

o Marginal Vitamin B-6 Nutrition During Lactation

Human studies were conducted which documented that American lactating women consumed diets which provided only 60 percent of the current Recommended Dietary Allowances (RDA) for vitamin B-6 and 44 percent of the RDA for zinc. The breast milk from these mothers provided only 16-40 percent of the RDA of vitamin B-6 to their infants. Supplementation of the mothers with 0.5 or 4 mg vitamin B-6/day doubled the vitamin B-6 status and concentration of vitamin B-6 in their breast milk without inhibiting lactation. There was no detectable difference in growth of the infants whose mothers received 4 mg vitamin B-6 compared to those who received the 0.5 mg supplement. Supplementation of the mothers with 25 mg zinc/day did not improve the apparent zinc status of the mothers, zinc concentration of the breast milk, or growth rate of infants.

o Nutritional Status of Lactating Women and Their Infants

Health and nutritional status was determined on 26 lactating women and their infants in six villages in the Kathmandu Valley of Nepal. The health status of the subjects was determined by means of an extensive physical examination and clinical analysis of blood samples. The dietary nutrient intake of the mothers was determined by analysis of duplicate dietary composites. The nutritional status of the mothers was determined from analysis of breast milk, blood and urine samples, and the nutritional status of the infants by analysis of blood samples. The dietary composite analysis indicated that the mothers were consuming very low amounts (about 9 percent of calories) of fat and high amounts of fiber. All the mothers had low protein and energy body reserves, and evidence of hepatitis A; 92 percent had evidence of intestinal parasites; 16 percent had symptoms of B-vitamin deficiencies; and 8 percent had urinary tract infections. In spite of these nutritional and health problems of the

mothers, all the breast-fed infants demonstrated adequate growth with no evidence of medical problems. Thus, the study demonstrated that breast-fed infants can be adequately nourished by breast milk alone even when the mother shows signs of nutritional inadequacy and multiple health problems.

4. Adult Nutrition

o Energy Cost of Protein Synthesis in Adult Women

The most prevalent nutritional problem in the United States is the tendency for most people to become overweight. Although this problem is in part due to a lack of exercise, other factors related to maintaining a balance between dietary energy intake and energy expenditure, are probably involved. Individuals may vary in how efficiently they use dietary energy for different metabolic processes, such as the synthesis of body protein. A significant amount of energy expended each day is used by the body to synthesize and replace body proteins. This relationship was evaluated in pre- and postmenopausal women by determining rates at which their body protein was being synthesized and broken down and by estimating their energy expenditures. The findings support the hypothesis that a relationship exists between energy expenditure and rate of protein synthesis. A maximal cost of protein synthesis, of 5.08 kcal gram, was determined from changes in protein synthetic rates and energy expenditure in response to feeding.

o Copper Retention in Young Men Suggest Lower Requirement

The current estimated adequate level of dietary copper, listed by the National Research Council, is substantially higher than the usual intake of Americans, but signs of copper deficiency have not been observed in normal, healthy people. The recommended intake was based on very little research data and it is important to know whether this recommendation is higher than necessary or if most of the population is at risk of copper deficiency. Copper absorption and retention were studied at three very different levels of intake with new techniques and discovered that the efficiency of absorption differs greatly at different copper intakes. Sufficient copper was absorbed at a dietary level slightly below the usual intake of Americans to replace the amount lost from the body. The results indicate that the current estimated adequate dietary levels are probably too high. The new data can be used to help establish a more realistic dietary copper recommendation.

o Exercise Increases Losses of Chromium and Zinc

Acute exercise may be a stress that leads to significant changes overall in metabolism. A study demonstrated that acute exercise leads to increased urinary losses in two trace elements that are in limited supply, namely chromium and zinc. Urinary chromium excretion of the untrained runners was significantly higher than that of the trained subjects, and urinary excretion of zinc was similar in trained and untrained groups. These data demonstrate that acute exercise and training alter trace element metabolism.

o Survey of Human Selenium Toxicity in China

The health and food habits of 175 families residing in areas of the People's Republic of China with low, moderate, and high soil selenium content were surveyed in an attempt to determine the maximum safe intake of selenium in the diet. Significant correlations were found between hair and blood selenium

(Se) levels, nail and blood Se, and urine and blood Se. Fluctuation in the dietary Se intake in the high Se area was so great that 3-day composite intake did not correlate well with the relatively stable Se levels seen in blood, hair, and urine. No cases of selenosis were observed among people who lived in the moderate Se area with long-term Se intakes less than 750 micrograms per day. No changes were observed as a result of Se exposure in a number of biochemical parameters including erythrocyte count, hemoglobin content, hematocrit, and serum alkaline phosphatase. Also, normal values for the urinary excretion of trimethylselenonium ion and blood prothrombin time were found only at dietary Se intakes below 750 micrograms per day.

o Trace Element Nutrition and Sleep Behavior in Women

Analysis of sleep behavior data collected from 41 adult women participating in five independent, live-in studies of trace element nutrition showed that bedtime, sleep latency, total sleep time, and sleep quality were affected by the level of dietary copper; bedtime, nighttime awakening, and total sleep time were affected by dietary iron levels; and, nighttime awakening and sleep quality were affected by the levels of dietary magnesium and aluminum. In both low-copper (0.8 mg/day) and low iron diets (5 mg/day), sleep time increased and its quality decreased. These findings indicate that trace element nutriture affects sleep patterns relevant to mood, behavior and cognitive ability.

o Decreased Vitamin B-6 Status of Submariners

Due to the psychological stresses associated with a submarine patrol, there is concern for the nutritional health of the men involved. Consequently, changes in the vitamin B-6 status of 23 submariners was investigated during a 3 month patrol. Approximately half the men were given a daily multi-vitamin supplement which provided 0.5 mg vitamin B-6 (about 1/4 the Recommended Dietary Allowance). The vitamin B-6 status was dramatically reduced during the patrol for both groups. However, the vitamin B-6 status of the men who took the multi-vitamin supplement was not as depressed as that of the men who did not take the supplement. No relationship was observed between the reduced vitamin B-6 status in either group of submariners and any mental depression reported by the men. Since adequate vitamin B-6 status is necessary for normal nerve function and adequate utilization of dietary proteins, fats and carbohydrates, submariners may require routine vitamin B-6 supplementation of greater than 0.5 mg per day to maintain adequate vitamin B-6 status.

o Iron Status Related to Tolerance to Cold

A study with women revealed that a low iron status can reduce their ability to regulate or maintain body temperature in the cold, thereby rendering them more susceptible to cold temperatures. In this study, six healthy young women were fed diets for 80 days containing less than one-third the Recommended Dietary Allowance for iron (4 mg/day). Their reduced ability to maintain body temperature during acute cold exposure occurred from their low iron status even though they were not anemic and showed increased oxygen utilization and elevated blood levels of the hormone, norepinephrine. The iron-depleted women not only generated less body heat when exposed to the cold but also lost more body heat than they did after a 114-day period of repleting their iron stores. More than half of the American women between ages 11 and 50 consume less than the recommended iron intake. This could explain why these women may be more affected by the cold.

5. Elderly

o Vitamin K Requirements of the Elderly

Preliminary evidence indicates that a significant proportion of free-living elderly have elevated levels of abnormal prothrombin, which may indicate a vitamin K deficiency. Abnormal prothrombin (required for normal blood clotting) is formed when the glutamic acid residues in the amino terminal portion of the molecule are not carboxylated to gamma-carboxyglutamic acid. Since this reaction requires vitamin K, elderly subjects with elevated levels of abnormal prothrombin may be suffering from a subclinical vitamin K deficiency.

A new assay for vitamin K1 in plasma was developed that requires a single high-performance liquid chromatography step and small volumes of plasma. For young females, plasma vitamin K1 concentrations are significantly lower than in all other ages and groups. The amount of gamma-carboxyglutamic acid excreted in the urine during a 24-hour collection may be an indicator of vitamin K nutritional status. A new automated HPLC assay for gamma-carboxyglutamic acid in urine has been developed for the evaluation of vitamin K status in human and animal models. Urinary excretion of gamma-carboxyglutamic acid was shown to decrease when rats were placed on a diet low in vitamin K.

o Nutrition and Immune Response in the Elderly

Aging is associated with declines in immune responsiveness due partially to increases in lipid peroxidation and prostaglandin formation. Dietary vitamin E supplementation in senescent mice increases immune responses presumably through decreased splenic prostaglandin E2 synthesis. Mice fed calorically restricted diets which prolong their life span and enhance immune responsiveness also decreased splenic prostaglandin E2 synthesis. Supplementation of a nutritionally adequate semi-synthetic diet with glutathione increased immune responsiveness though not via prostaglandin E2 mediation. Old mice possess significantly less natural killer cell activity than young mice. Vitamin E supplementation produced an increase in natural killer cell activity in old mice. Old mice fed fish oil tended to have less activity than young or old animals fed diets containing the same level of corn oil. Decreased antigenicity and tumorigenicity of cell lines were observed in vitamin E treated animals. Nutritional manipulation of the aged immune system with dietary antioxidants may be a practical and inexpensive approach to improving the declining immune responsiveness of the elderly.

o Nutrition Epidemiology and Aging

Nutritional epidemiology is being applied to identify the possible effects of nutritional status on more subtle biochemical, physiological and behavioral alterations which typify the aging process. Two major epidemiologic studies are currently underway to assess the role of nutrition in aging. One study has measured the diet and nutrient supplement use of both free-living and institutionalized individuals 60 years of age and older. In this sample of overtly healthy elderly, there was no evidence of protein deficiency. Although plasma concentrations of albumin, prealbumin and transferrin declined with age, this decline was not related to protein intake. Based on this

sample of elderly, it was concluded that atrophic gastritis is common in the elderly, and the atrophic gastritis is associated with vitamin B12 deficiency and anemia. This study also has suggested a role for ascorbic acid in cholesterol metabolism. Individuals with higher plasma levels of ascorbic acid tended to have higher HDL cholesterol levels. The second study examined the influence of nutrition on the occurrence of senile cataract. Results suggest that carotenoids, vitamin C, and folate may play a role in preventing or delaying the onset of cataract.

o Nutrition and Aging in Skin-Derived Cells

Calcium has been found to enhance confluent density of cultured human fibroblasts in an age-dependent fashion. Strontium substitutes in some but not all calcium pathways controlling human keratinocyte growth and differentiation. Inositol is a required nutrient for cultured human keratinocytes, with optimal proliferation obtained at concentrations approximately 10-fold higher than required for other cell types. Inositol responsiveness decreases markedly with age of cell donor. Choline, in the presence of sufficient inositol, also stimulates keratinocytes proliferation. Solar simulated ultraviolet irradiation directly induces pigment production by cultured human melanocytes. Retinoids, but not Vitamin D, appear to mediate UV-induced tanning. Human keratinocyte and fibroblast responsiveness to autocrine growth regulators varies markedly with cell donor age, with old donor cells less responsive to interleukin 1 and more sensitive to interferon. Keratinocyte and fibroblast responsiveness to exogenous growth factors and nutrients declines markedly between the newborn and adult periods, with further decline during adulthood. Human keratinocytes activate thyroxine to triiodothyronine, suggesting an important new endocrine function of human skin.

o Diet and Exercise Studies in the Elderly

The effects of aerobic exercises were compared in young and elderly men and women. Increases in functional capacity were found to be similar between the two groups, although the older subjects demonstrated peripheral adaptations in skeletal muscle. The effects of high resistance strength training were examined in elderly men, with half receiving a daily calorie and protein supplement. Muscle strength, total thigh and muscle areas, and Type I and II fiber numbers were increased. The men consuming the supplement showed a gain in weight with increases in muscle and fat mass.

The effects of regular exercise in young and middle-aged endurance athletes showed hours spent exercising correlated closely with fat mass, energy needs, and V02 max. There was no age-related effect in these parameters, indicating these changes may be due to decreased physical activity and not age. Exercise-induced muscle damage caused a rise in serum interleukin-1 levels, delayed increase in muscle protein breakdown (leucine oxidation) and impaired capacity for glycogen storage. In older men, the same exercise induced less interleukin-1, more muscle damage and greater rises in muscle protein breakdown.

o Nutrition and Free Radical Reactions in Aging

Chronic ethanol feeding was found to stimulate age-related decreases in microsomal enzyme activities and total hepatic vitamin E content via lipid peroxidation events. Aging is associated with increases in the synthesis of prostaglandin E2, thromboxane B2, and prostaglandin I2 in mice. Dietary

manipulation of fat and vitamin E content altered age-related changes in thromboxane B2 and prostaglandin I2 and the lipoxygenase product leukotriene B4. Mice fed fish oil diets were found to have lower plasma and tissue levels of prostaglandin E2 and vitamin E than those fed corn or coconut oil. Vitamin E supplementation decreased synthesis of prostaglandin E2 and altered platelet aggregation via changes in thromboxane A2 and prostaglandin I2. Some tissues have a higher metabolic demand for vitamin E and the increased rate of and susceptibility to lipid peroxidation during senescence may lead to increased dietary vitamin E requirements with aging. Vitamin E and dietary fat affect the arachidonic acid cascade and influence the oxidative synthesis of lipoxygenase and cyclooxygenase products with undiscovered consequences for age-related changes in these metabolic pathways.

6. Nutrient Functions

o Effect of Zn Deficiency

Inhibition of sexual maturation in male humans and animals has long been associated with low zinc status. The biochemical mechanism by which this occurs is not understood at the present time. Recently it was shown that the enzyme that produces angiotensin II, a very potent vasoconstrictor, is important in sexual maturation. This enzyme, called angiotensin converting enzyme (ACE), is a zinc-dependent enzyme. It was shown in this study that ACE activity is significantly impaired in the testes and epididymides of zinc deficient male rats, suggesting that impaired sexual maturation in zinc deficiency may be related to the reduced activity of ACE. This study also demonstrates that testosterone levels, usually reduced in zinc deficiency, are probably not involved in maintaining ACE activity in the male reproductive organs.

o Early Trace Element Deficiencies Impair Longterm Development

It was observed that rat pups, delivered and nursed by dams fed copper-deficient diets, exhibit long-term depressed copper status despite post-lactational copper repletion as measured by enzymatic ceruloplasmin activity and plasma copper concentrations. Previous work had shown that rat pups nursed by dams fed zinc-deficient diets exhibit long-term changes in bone mineral metabolism despite post-lactational zinc repletion.

o Fructose Increases the Dietary Requirement for Copper

Previous studies have shown that dietary sucrose and fructose, compared to starch and glucose, exacerbate the consequences of copper deficiency in rats, swine and, perhaps, humans. The indicators commonly used to assess copper status lack the sensitivity required to elucidate the basis for this copper-carbohydrate interaction. A study was done to determine if the activity of the immune system provides a sensitive tool for investigating the interaction. The results showed that fructose rapidly attenuated the humoral immune response of copper deficient rats compared to starch. Supplementation of copper deficient rats with adequate copper rapidly restored immunocompetence to control levels. Rats fed the diet with fructose required 2-3 fold more dietary copper than those fed starch. These data provide the first quantitative evidence that dietary fructose, compared to starch, increases the dietary requirement for copper.

o Effect of Dietary Copper Deficiency on Heart Rate

A study was conducted to determine whether innervation of the heart is altered in copper deficiency. This was done by testing the function of the vagus nerves. These reside in the neck, are easy to isolate and have a profound effect on heart rate. They contain primarily inhibitory fibers (which slow heart rate) but also some excitatory fibers. These nerves were surgically isolated, stimulated electrically over a range of voltages and, by use of an electrocardiogram, effects on heart rate monitored in both copper adequate and copper deficient rats. It was found that the strong inhibitory effect on heart rate normally seen with vagal stimulation is significantly reduced in copper deficiency, but only with right vagal stimulation. The inhibitory effect of the left vagus were not affected. These findings suggest that the excitatory components of the vagus are impaired in copper deficiency and that nervous control of heart rate may be impaired in copper deficiency.

o Plasma Carotenoid Response to Selected Vegetables

Current epidemiologic evidence has implicated a possible protective role of fruits and vegetables against certain forms of cancer, with interest centering on the carotenoid pigments in these foods as the constituents responsible. A study was conducted to determine the serial changes in seven plasma carotenoid fractions in normal men maintained on a controlled, low-carotenoid diet after a single ingestion of either a food high in one or more carotenoids, or a dose of pure B-carotene. Changes in various other plasma lipid components were also determined. It was found that (1) normal subjects vary widely in their efficiency of absorption of carotenoids; (2) large intakes of carotenoid-rich vegetables produce small or negligible increases in plasma concentrations of carotenoids; (3) an individual's plasma carotenoid pattern is relatively constant over time; (4) plasma lipoproteins, the carriers for carotenoids, appear to have a limiting capacity for uptake of these pigments.

o Effect of Dietary Fat on Immune Status

A decrease in the intake of total fat calories and an increase in the proportion of polyunsaturated type of dietary fats has been advocated by some groups to lower the risk of cardiovascular diseases. However, it is not known how such diets may affect the immune status which determines one's ability to fight infections. The effects of different types of polyunsaturated dietary fats on the immune status of rabbits have been compared. It was found that a linseed oil containing diet which is rich in n-3 type of polyunsaturated fat markedly enhanced several indices of the immune status when compared to those of the rabbits fed diets containing menhaden oil, safflower oil, or the hydrogenated soybean oil. This improved responsiveness in the rabbits fed linseed oil diet may enhance their ability to fight infections. These findings may have implications for improving the immune system of immuno-compromised individuals.

B. Role of Nutrition in Health Promotion and Prevention of Diet-Related Disorders

1. Energy Metabolism and Weight Maintenance

o Energy Balance Studies

A 12-week study was conducted using the new USDA Room Calorimeter with 12 moderately obese men, half of whom were placed on a weight restriction diet. A preliminary conclusion is that energy expenditure is decreased following a reduction in caloric intake and a further reduction occurs with subsequent weight loss. In another study, N-15 glycine was used as a label to estimate protein synthesis rates in 25 adult men previously maintained on diets in which fat provided either 20 or 40 percent of calories. Protein synthesis rates, but not glucose production, significantly decreased with increased dietary fat. Energy expenditure following meal consumption was measured in 42 men to identify the energy costs associated with diet digestion and absorption, and storage of nutrients following meal consumption, i.e., diet induced thermogenesis. All of these studies have direct application in identification of the consequences of various dieting schemes for weight maintenance and weight reduction.

o Metabolic Responses to Different Forms of Starch in Humans

As people age, a greater percentage show an abnormal carbohydrate metabolism as indicated by elevated fasting blood glucose or insulin levels or an elevated response after a glucose tolerance test. Changes in diet should be considered as the simplest way to control the level of blood glucose to within normal range. To investigate whether long-term feeding of amylose would remain as effective in lowering postprandial glucose and insulin responses as observed in the previous acute testing, twelve men were fed a diet containing 34 percent of their calories as either 70 percent amylose or 70 percent amylopectin (forms of starch) for 5 weeks. No significant differences were observed in glucose or insulin levels when a glucose tolerance was given after 4 weeks on each starch. However, glucose, insulin and glucagon responses were significantly lower when a meal containing amylose compared to amylopectin was consumed after 5 weeks on each starch. Mean fasting triglyceride and cholesterol levels, but not high density lipoprotein cholesterol, were significantly lower during the period when amylose was the main starch consumed. Long term intake of diets high in amylose starch may be beneficial to individuals showing an intolerance to a standard carbohydrate diet, obese or diabetic individuals exhibiting elevated glucose levels and apparent insulin resistance, and hyperlipidemic individuals.

o Effects of Eating Patterns on Gastric Emptying

Research designed to develop new stratagems for preventing tendencies toward obesity has focused on gastric emptying, the rate limiting step in digestion, and on the circadian rhythmicity of the gastric emptying response to eating. This work was motivated by evidence that fiber, edible gums and foods that produce relatively small responses in blood glucose exert beneficial metabolic effects largely by repressing the peak daily rates of nutrient absorption. The hypothesis was tested that eating patterns influence the amplitude of the circadian rhythm for gastric emptying response to food. Rats were trained to eat either two widely spaced, equal-sized meals or a single large meal per day and then tested at various times of day for their gastric emptying responses

to a standard test meal. This response tended to be slower in rats given two meals as compared to those given only one large meal. Serum insulin after eating was greater at times of rapid than slow gastric emptying. It appears likely that the impaired glucose tolerance of human "gorgers" is associated with an exaggerated rhythm in gastric emptying response to food and that peak daily rates of gastric emptying influence metabolism in part through effects on peak daily insulin levels.

2. Fats and Dietary Fiber

o Dietary Fat and Fiber Level Studied

Recommendations for decreasing fat and increasing fiber intake have been made by several health agencies. In spite of this, the precise effects of a low-fat/high-fiber diet on various metabolic parameters related to colon cancer and other degenerative diseases remains unknown. In a controlled dietary study, 42 healthy men, 19-56 years of age, consumed a low-fat high-fiber (modified) diet and a high-fat, low-fiber (regular) diet, for two 10-week periods in a crossover design. Fat was reduced from 40 percent of calories in the regular diet to 19 percent in the modified diet. Neutral detergent fiber was increased from 12.2 g (regular) to 31.1 g (modified). Cholesterol was lowered to an average intake of 210 mg/day on the modified diet as compared to 530 mg/day on the regular diet. Blood lipids and lipoproteins, important risk factors for cardiovascular disease, were lowered by the modified diet. Low density lipoprotein cholesterol was reduced by 18-21 percent by the modified diet, and this reduction was not dependent on initial (pre-study) LDL-cholesterol levels. However, both LDL and HDL cholesterol were lowered in the same proportion.

o Effects of Dietary Fatty Acids on Platelet Function

Prostaglandins, hormone-like compounds derived from dietary essential fatty acids, influence key clinical parameters such as blood flow, vascular tone, platelet reactivity, and plasma lipids. To further the understanding of the role of prostaglandins as mediators of dietary fat effects on cardiovascular and other degenerative diseases, a stable-isotope dilution method to quantitatively assess whole-body synthesis of prostaglandins in human volunteers was developed. This procedure is being utilized to determine prostaglandin E levels in adult male volunteers fed low-fat, high-fiber diets as compared to a typical American diet high in fat.

o Omega-3 Fatty Acids and Blood Clotting

Recent interest also has centered on the role of highly unsaturated dietary fatty acids, mainly from fish oils, on various parameters related to human health. These are often referred to as either omega-3 polyunsaturated fatty acids, as distinct from those of the omega-6 family of fatty acids formed from linoleic acid, the principal essential fatty acid in vegetable oils. Using platelets to assess effects which may be related to blood clotting, it has been found that only receptor-mediated responses are altered by dietary omega-3 polyunsaturated fatty acids. A probe that bypassed membrane receptors showed no differences in responses of platelets from rats fed a corn oil versus a fish oil diet.

o Hormone Balance Modulated by Dietary Lipids in Women

Dietary fat has been shown to alter plasma lipid levels. Lipid metabolism is controlled by several hormones. Further, lipid metabolism is also affected by the menstrual cycle in women. Therefore, the effect of dietary fat on several hormones which are involved in lipid metabolism in normal women during different phases of their menstrual cycle was studied. Human subjects were fed diets high in fat; then switched to diets low in fat. It was found that dietary fat level altered the levels of the hormones insulin, glucagon, cortisol and dehydroepiandrosterone-sulphate. Plasma insulin and growth hormone were also affected by the menstrual cycle. These findings indicate that dietary fat intake results in adaptive changes in hormonal balance in normal human subjects.

o Dietary Fat Effects on Lipoproteins and Cell Membranes

The plasma lipoproteins, VLDL, LDL, and HDL were observed to become significantly more fluid when 43 men, ages 19-56, consumed an experimentally designed low-fat, high-fiber diet than when they ate a "regular," high-fat, low-fiber diet. The experimental diet provided 19 percent of energy from fat with polyunsaturated to saturated fatty acid ratio (P/S) of 1.31 and 31.1 g neutral detergent fiber per day while the "regular" diet had 40 percent energy from fat, a P/S ratio of 0.6 and provided only 12.2 neutral detergent fiber per day. The LDL cholesterol decreased significantly when the men ate the experimental diet, thus reducing an important cardiovascular risk factor. Chemical analysis showed changes in fatty acids and lipid classes including cholesterol, phospholipid, and triacylglycerol. Data analysis described the role of these fractions in determining fluidity. Fluidity is expected to modulate interactions between lipoproteins and cellular receptor proteins. This is very important with respect to LDL; as LDL-receptor activity controls blood levels of LDL cholesterol. These data are of immediate value to scientists studying the biochemistry of dietary fats and atherosclerosis.

o No Mutagenic Effect of High Fat Diets Found

Fecal mutagenicity is believed to have increased in groups eating high-fat diets, the same groups who are often found to have high colorectal cancer incidence and mortality. Fecapentaenes are the best characterized class of fecal mutagens, but the relationship of dietary fat intake to their excretion is unknown. Therefore, the effect of changes in amount and type of dietary fat on fecapentaene levels in 31 premenopausal women 20-40 years of age was studied. After a pre-diet free-living period lasting one menstrual cycle, women were placed on a high-fat diet (40 percent energy from fat) for four menstrual cycles and then switched to a low-fat diet (20 percent energy from fat) for an additional four menstrual cycles. One-half the subjects were maintained throughout the study at a ratio of polyunsaturated-to-saturated fatty acids of 1.0, the other half at 0.3; body weight was kept constant. Fecapentaene and fecapentaene precursor levels were measured in acetone extracts from 3-day pooled stool samples. No differences in fecapentaene or precursor levels were observed between the high- and low-fat diets at either P/S ratio. Fecapentaene and precursor levels were higher while on controlled diets than during the pre-diet free-living period, and levels declined again in the post-diet free-living period. It is concluded that dietary fat has no significant effect on fecapentaene or precursor levels in acetone extracts of stool in premenopausal women. The effects of other dietary or non-dietary factors remain unknown.

3. Reduction of Cardiovascular Risk Factors

o Copper Deficiency and Cardiovascular Risk Factors

Hypertension was produced in adult rats by a diet low in copper. This finding ties copper deficiency to a fifth factor predictive of risk of ischemic heart disease, the leading cause of death in the United States. Animals deficient in copper and people with ischemic heart disease exhibit a number of similarities. The most important of these are glucose intolerance, hypercholesterolemia, abnormal electrocardiograms, hyperuricemia, and hypertension.

o Dietary Fructose and Risk Factors for Heart Disease

Fructose is entering the food supply in the United States in increasing quantities as a sweetener in high-fructose corn sweeteners. Comparatively few human studies have determined the overall metabolic effects of fructose intake on risk factors associated with diet-related disorders. A human study was, therefore, conducted in which ten hyperinsulinemic and eleven control men consumed a typical American diet with 20 percent of calories from either fructose or starch for 5 weeks in a crossover design in order to determine the effects on various blood metabolites considered to be risk factors for heart disease. Fasting plasma was analyzed for total triglycerides and cholesterol and triglycerides and cholesterol contents of the lipoprotein plasma subfractions. Apolipoproteins (APO) A-1 and B-100 in total plasma and APO C-2 and C-3 in the very low density plasma fraction also were analyzed. Significant increases were observed in total triglyceride and cholesterol when comparing the fructose to the starch diet. Except for HDL cholesterol, significant increases occurred in the triglyceride and cholesterol content of the plasma subfractions with the fructose diet. APO B-100, C-2 and C-3 also were significantly higher when the subjects ate the fructose diet. However, the increase in total triglyceride and APO B-100 due to fructose feeding was present only in the hyperinsulinemic males. These results indicate that dietary fructose can adversely alter several risk factors associated with heart disease in humans.

o Vitamin C and Lipoproteins in the Elderly

The relationship between plasma ascorbic acid and high density lipoprotein cholesterol (HDL) was examined in a population of 235 males and 444 females age 60 to 97 years. The results indicate that persons with higher plasma ascorbic acid levels tended to have higher HDL levels. However, this association was seen to diminish with age. The association between plasma ascorbic acid and high density lipoprotein cholesterol was not due to other factors that may have differed between persons with high and low plasma ascorbic acid such as age, sex, amount of body fat, alcohol intake or smoking. The association between total plasma cholesterol and plasma ascorbic acid also was examined but no association was observed. It is well known that persons with a larger portion of their total cholesterol in the HDL fraction are at lower risk of coronary heart disease. If this association between plasma ascorbic acid and high density lipoprotein cholesterol is confirmed, it would suggest that coronary heart disease risk may be modified through dietary vitamin C.

o Calcium May Regulate Apo B Production

After fat is eaten, it is broken down and absorbed in the intestine as fatty acids. The fatty acids are then formed back into regular fat (triglyceride) and packaged along with a protein (apolipoprotein B) into large fat-rich particles known as chylomicrons. These particles reach the bloodstream and then are broken down. Using a new intestinal cell line known as Caco-2, it has been shown that incubation with fatty acids of various types has no effect on apolipoprotein B production but does change the fat content of the particles that are produced. However, altering the calcium concentration within Caco-2 cells has a significant effect on apoB production. The findings implicate the involvement of calcium ion in the regulation of intestinal apoB synthesis and secretion, the major protein of the low density lipoproteins.

4. Bone Density and Osteoporosis

o Nutritional Factors in Preventing Age-Related Loss of Bone Density

To define the relationship between calcium intake and rate of bone loss in healthy postmenopausal women, a longitudinal, double-blind placebo-controlled calcium-intervention field trial is being conducted. Over the past 15 months, 360 women with usual calcium intakes under 650 mg daily have been enrolled. Bone density measurements of the hip, spine, heel, and forearm will be measured annually for 5 years. Serum biochemistries and dietary intake are being monitored twice annually. The extent to which calcium intake affects mineral loss from the skeleton will be measured in a population at risk for osteoporosis. Long-term precision of dual-photon absorptiometry as well as bone scan data in subjects screened for the field trial have been evaluated.

A method for measuring fractional whole-body retention of orally administered non-radioactive labeled calcium has been developed and is currently being used to determine the magnitude and timing of intestinal adaptation to lowered calcium intake. After a diet change from 2,000 to 300 mg calcium daily, significant increases in 1,25-dihydroxyvitamin D and calcium retention occurred within 1 week. The calcium retention remained fairly constant over a two-month low-calcium period, whereas the active vitamin D concentration declined to baseline. Thus, it appears that a factor other than 1,25 (OH)₂D may stimulate calcium absorption in subjects on a low calcium diet.

o The Role of Boron in Bone Calcification

Recent experiments using rats have shown that boron may have a role in the metabolism of major mineral elements such as calcium, magnesium, and potassium. Thus, boron may have a role in disorders showing a change in major mineral metabolism, e.g., osteoporosis. In this study, boron deficiency in the diet of rats depressed the concentration of calcium in bone. Boron deficiency also affected the concentrations of other major minerals including magnesium and potassium in bone, kidney, and liver; however, the changes were influenced by the amount of magnesium and potassium in the diet. The findings indicate that boron alone, or through an interaction with potassium and magnesium, affects major mineral metabolism, and further support the hypothesis that poor boron nutrition might be involved in some calcium metabolism disorders of unknown cause including osteoporosis.

C. Food Composition and Nutrient Bioavailability

1. Improved Methods

o Improved Methods for Analysis of Inorganic Nutrients in Foods

Slurry sample preparation for graphite furnace atomic absorption spectrometry (AAS) is being developed with ultrasonic agitation for effective mixing. Microwave sample preparation (wet ashing) is being evaluated and appears to be an attractive alternative to conventional ashing methods. A graphite furnace AAS method for chromium (Cr) has been developed and is being used to analyze foods. Collaboration with HNIS continues in an effort to improve the quality of nutrient composition data obtained by contract. Implementation of quality control checks is facilitated by using food quality materials developed (tuna, cottage cheese, chicken nuggets, bread, turkey).

o Improved Methods for Analysis of Dietary Fiber and Sugars

After a thorough evaluation of the AOAC - approved Total Dietary Fiber (TDF) method, a simplified procedure based on the same principles as the official method was developed and tested on different types of foods. TDF values obtained using the two methods were in good agreement. A manuscript entitled "Simplified Method for the Determination of Total Dietary Fiber in Foods" has been submitted to the J. Assoc. Off. Anal. Chem. Since the Official Method is more labor intensive, this method should be of interest to most food analysts.

Optimum gas chromatographic conditions have been determined for the separation and quantitation of alditol acetates of monosaccharides on a capillary column. The techniques will be applied to the identification of sugars in polysaccharides hydrolysates. Individual sugar components of dietary fiber are of particular interest to researchers working in the area of diet and health relationship. Total daily diet composites and their individual foods were analyzed for sugars and starch. Comparisons were made between the analyzed values and those calculated from Food Table values; results indicated that calculated values tend to overestimate sugar and starch contents of foods.

o International Collaborative Research in Dietary Fiber Analyses

The Human Nutrition Information Service (HNIS) and the Agricultural Research Service's Nutrient Composition Laboratory (NCL) are participating with laboratories in the United Kingdom, Canada, and the United States in a joint study to conduct dietary fiber analysis of 50 U.S. foods, including blind duplicates, by the Association of Official Analytical Chemists (AOAC) procedure and by one or two of three other procedures including the methods of Englyst (official in the U.K.), Mongeau (official in Canada), and Li (AOAC simplified procedure of NCL). Reliability of analytical methods used to assess dietary fiber content of foods is variable. Comparisons of results will be made by type of analytical procedure and by laboratory in an effort to improve the reliability of dietary fiber analysis.

o Improved Methods of Lipid Analysis in Foods

Several improvements have been made in the methodology for collection, validation and reporting of lipid nutrient data in human foods. Highlights are as follows: (1) Analysis of food fatty acids by gas chromatography: separation and quantification was made more efficient due to the application of cross-linked Carbowax-20M, fused silica capillary columns, which enhanced

the method by virtue of their inertness, and their elimination of the difficulties due to chain-length overlap in the elution of fatty acids, (2) Analysis of cholesterol and plant sterols (both free and esterified) in fats/oils: preliminary extraction with mixtures of methanol and water increased sample throughput, while providing a simple way to obtain separate results for the esterified and unesterified forms, (3) A data management system has been developed and implemented to collect, report, and manage all chemical and descriptive data. Computerized factor analytic techniques (pattern recognition) have been implemented to speed the process of data validation.

- o Reference Standard for Nutrients in a Mixed Diet

A Memorandum of Understanding has been established between the U.S. Department of Agriculture (USDA) and the National Bureau of Standards (NBS) to initiate joint activities in development of food and nutrition related Standard Reference Materials. These activities have included production of a replacement for the soon-to-be exhausted supply of a mixed diet reference standard. Materials for a new supply were collected from the Food and Drug Administration (FDA) Total Diet Study, homogenized and prepared in a joint USDA-FDA-NBS project. Analytical certification of the new diet mixtures for proximate, inorganic and selected organic nutrients has been conducted prior to distribution by NBS to the world-wide scientific community. Activity on chemical speciation has commenced with development of GC/MS methodology for selenoamino acids. A batch of 19 diet samples from other countries in the core program have been analyzed. Completion of this project in 1989 will result in a unique set of data on world-wide dietary intake of trace elements.

2. Food Composition

- o National Nutrient Data Bank

HNIS continues to maintain the National Nutrient Data Bank (NNDB) as the primary mechanism for collecting, evaluating, storing, and collating nutrient composition data of foods. Products of the NNDB are reference values for over 60 food components in thousands of foods Americans consume, including many foods consumed primarily by specific ethnic groups. They are presented in published tables and reports and in machine readable forms for a variety of users. The products are widely recognized as authoritative and are used throughout the world. Of special importance are the data bases prepared for use in assessing the nutrient content of diets reported in large-scale dietary intake surveys conducted by HNIS and by the National Center for Health Statistics (NCHS) in DHHS. The NNDB is expanded on a continual basis to include results from new analyses conducted by industry, government, universities, and from extramural analyses funded by HNIS. Data reliability is emphasized by utilizing (1) sampling plans representing the national distribution of food types, (2) evaluating performance on test sample analyses during the contractor selection process, (3) requiring validated analytical methods and documented quality control procedures during contract performance, and (4) promoting uniformity of procedures by cooperation among contractors and annual meetings of principal investigators. Plans for extramural research--priorities and procedures--are made in consultation with ARS Nutrient Composition Laboratory and, as appropriate, other agencies which are major users of nutrient composition data within and outside of USDA and the food industry. Research emphasis is in two areas: food components believed to be important to health promotion and disease prevention, and research to fill knowledge gaps for the data base.

Analyses were conducted to fill data gaps, especially on the composition of foods newly marketed, with changed marketing practices or reported as consumed in national surveys. Examples are ground turkey meat, speciality fruits, recipe-prepared foods, and fried foods. A study was completed to test reliability of recipe calculations. Food components receiving emphasis in extramural analyses and cooperative efforts were those believed to be important to health promotion and disease prevention for which data were insufficient to assess diets. For example, studies are underway on the selenium content of foods by geographic region of the country; trace mineral content of foods including copper, magnesium, manganese, and zinc; and variability in sugar content of selected foods. Cooperative efforts with industry and commodity groups are underway to study nutrient composition of chicken eggs and to develop protocols for nutrient and yield studies of red meats. Changes in the nutrient data base for levels of iron and fat in food items between 1977 and 1985 were studied using food consumption data and supporting reference files for the nutrient data base. Food items accounting for 80 percent of women's intake of iron and fat reported in 1985 food intake surveys were determined. Changes in the iron and fat levels for these food items between 1977 and 1985 based on product and data base changes were estimated and compared to mean intake. For both fat and iron, product change between 1977 and 1985 was greater overall than data base changes.

- o Composition of Fast Foods

Data on the composition of foods available in the U.S. from limited-menu and carry-out restaurants commonly known as "fast foods" were generated, collected and compiled and published in "Composition of Foods...Raw, Processed, Prepared," Agricultural Handbook No. 8 (AH-8). The new section includes values for more than 150 fast-food items in seven categories: beverages, breakfast items, desserts, entrees, Mexican foods, sandwiches and burgers, and side dishes. A computerized data set for the new section was issued and the Nutrient Data Base for Standard Reference was revised accordingly.

- o Publication on Sugar Content of Foods Released

Newly compiled data on the sugar content for over 500 food items was released in a new publication "Sugar Content of Selected Foods; Individual and Total Sugars," Home Economics Research Report No. 48. This is the first comprehensive table of the sugar content of American foods and includes simple and complex sugars as well as total sugar contents. Data are provided on both a 100-gram and household measure basis.

- o Provisional Table on Dietary Fiber

Provisional tables of food components of special interest to professionals are issued for a selected number of frequently consumed foods as reliable data become available. A provisional table of total dietary fiber values for about 300 frequently consumed foods was issued. Values were determined by the AOAC method, currently the most acceptable standard for determining dietary fiber levels of food.

- o Special Data Bases for Large-Scale Dietary Intake Surveys

Special data bases for use in assessing the content of food energy and 27 nutrients in diets reported in USDA's system of Nationwide Food Consumption

Surveys and DHHS' Health and Nutrition Examination Surveys and others are developed, documented and maintained by HNIS. Data bases involved are Nutrient Data Base for Individual Food Intake Surveys and Nutrient Data Base for Household Use Surveys. These data bases must contain nutrient values for all foods reported in the surveys. Both data bases were updated with nutrient values and recipes as required for the 1987-88 Nationwide Food Consumption Survey. This included revision of beef recipes to reflect current market trimming practices. The Nutrient Data Base for Individual Food Intake Surveys was provided to NCHS for the NHANES III. These special data bases are also made available on data tape for public use.

o Market Basket Studies on Composition of Meats

Studies have been designed in collaboration with industry to measure the composition of beef and pork in the retail meat case of predominant supermarkets in 12-14 major cities of the United States. For each retail cut of beef, fat thickness was measured, seam fat scored, and package information recorded. Randomly selected retail cuts were sent to Texas A&M University, dissected into lean, fat and bone, and the fat content of the lean quantitated. Trim fat was found to average about 0.11 inch. The pork study has not yet been initiated. Composite samples of these cuts also will be analyzed for protein and fatty acids. Data from these studies, funded largely by industry, are being used to update food composition data tapes and handbooks, thus allowing nutritionists, dietitians, and public health officials to more accurately estimate nutrient intakes from these foods.

o Enhancement of Nutrient Composition of Meat from Sheep

Meat from young intact male sheep (rams) was found to contain significantly less fat than meat from castrates. Furthermore, the fat present in ram lambs is higher in polyunsaturated fatty acids. Fat deposition in cattle also can be significantly and favorably reduced in wholesale cuts by adjusting the relative balance of dietary protein and energy. This research enables industry to maximize its production and processing potential for acceptable meat products.

o Poultry Liver--A Chromium Source

There are presently no known foods that are particularly good sources of dietary chromium. Not only is the normal dietary intake of chromium suboptimal but marginal intake of chromium is linked to maturity-onset diabetes and cardiovascular diseases. A study conducted with turkey hens fed four levels of chromium demonstrated that poultry liver may be a good dietary source of chromium. Uptake of chromium in dark or white meat or in eggs was not increased sufficiently to serve as good dietary sources.

o Cholesterol Content of Eggs Studied

The Agricultural Research Service (ARS), the Agricultural Marketing Service (AMS), and the Human Nutrition Information Service (HNIS) are assisting the egg industry with a nationwide study to determine the cholesterol content of shell eggs.

ARS and HNIS helped to select the appropriate methods and research. AMS assisted in the selection of the 200 egg handlers nationwide whose eggs were used and, on June 27, began collecting eggs in official USDA plants and preparing them for shipment to the laboratory. The findings will be utilized by HNIS when the nutrient data base for Agriculture Handbook (AH) 8-1 is updated and can be used by other Government agencies when questions about labeling and advertising arise.

3. Bioavailability

o Bioavailability of Calcium and Phosphorus Sources for Infants

Very low birth weight infants (premature infants) have greater nutrient needs than infants born at term. Special formulations have been designed to provide minerals, amino acids (protein), and energy sufficient to approximate rates of growth that would have occurred had the infant been born at term. Two milk formulations, human milk fortified with a commercial formulation and a cow milk-based formula were evaluated. Infants fed fortified human milk absorbed and retained less calcium and phosphorus than those fed the cow milk-based formula. The data suggest that the calcium and phosphorus in the fortified human milk may have been in a form which is not absorbed readily by the body. Studies are now being conducted with the young miniature pig to determine the bioavailability of calcium and phosphorous sources used in infant formulas.

o Bioavailability of Chromium to Lactating Women

Dietary chromium intake, urinary excretion, serum concentration and absorption of lactating mothers was measured to determine if lactating mothers have altered chromium metabolism. Urinary chromium excretion of the lactating women (0.37 ± 0.05 ug/day) was significantly higher than that of controls (0.19 ± 0.02 ug/day). Serum chromium and chromium absorption were also higher for the lactating mothers compared to control women. There was an inverse correlation of chromium absorption and dietary chromium intake. Urinary chromium excretion was independent of dietary chromium intake in both lactating and control women. These data demonstrate that lactating women have higher chromium absorption and excretion than controls.

o Effects of Calcium on Iron Absorption

Because of the link between calcium deficiency and osteoporosis, calcium supplements are being widely used by adult women to prevent age-related loss of bone density and the development of osteoporosis. A potential adverse effect of calcium supplements taken with a meal is an alteration in absorption of trace minerals. Mixed effects of calcium on iron and zinc absorption have been reported. A study was done to measure the effect of calcium level on iron and zinc absorption. Iron absorption from a test breakfast meal was reduced by greater than 50 percent when 500 mg of elemental calcium (62% of RDA) as either calcium carbonate or hydroxyapatite was taken with the test meal. No alteration in zinc absorption was observed. This study suggests that iron, but not zinc, absorption from meals will be significantly reduced if large amounts of calcium are consumed with meals.

o Bioavailability of Other Minerals in High Calcium Diets

Whole wheat products are good sources of dietary fiber, complex carbohydrates and minerals for humans. However, phytic acid present in the bran of wheat can complex with nutritionally essential minerals and decrease their utilization. Therefore, a metabolic balance study was conducted to investigate the influence of calcium intake on mineral balance of adult men consuming a moderately high amount of phytic acid from wheat bran. Three levels of calcium were fed, the highest (1570 mg) approximating recent recommendations to prevent osteoporosis in females. Copper balance was not influenced by the different calcium intakes. Manganese balance tended to be only slightly lower when high calcium was consumed. Fecal magnesium excretion decreased with increasing calcium intakes, but urinary magnesium increased also resulting in no influence of level of calcium on net magnesium balance. Fecal and urinary excretion of phosphorus responded opposite to magnesium, but phosphorus balance was unaffected by level of dietary calcium. The results indicate that adult men can maintain copper, manganese, magnesium, and phosphorus homeostasis when consuming up to about twice the Recommended Dietary Allowance of calcium in diets with a moderately high intake of fiber and phytic acid from wheat bran.

o Absorption of Copper

Absorption and excretion of endogenous copper were found to vary simultaneously in rats fed diets deficient to luxuriant in copper. At low concentrations of dietary copper, changes in copper absorption are most important in maintaining homeostasis; at high concentrations, changes in endogenous excretion are most important. Measurement of copper absorption by whole-body counting or by isotope dilution gave the same results. Using the isotope dilution method, no effect of six dietary carbohydrates on copper absorption or endogenous excretion was found. Absorption of copper-65, whether incorporated intrinsically or extrinsically, in goose meat, goose liver, or peanut butter did not differ in humans. Absorption of copper from these foods ranged from 52 to 65 percent. Absorption of copper was significantly higher from goose liver than from goose meat or from extrinsically labeled sunflower butter.

o Factors Influencing Bioavailability of Dietary Iron and Zinc

The effects of folic acid supplements on zinc absorption and retention were studied in 10 men and 10 women. Both acute and chronic folate supplements (400 micrograms/d) decreased zinc absorption in individuals who absorbed more than 30 percent of a zinc dose when no folic acid supplement was given. Folic acid did not adversely affect zinc absorption in those individuals who absorbed less than 30 percent of the zinc dose.

The effects of high dietary ascorbic acid on iron repletion was studied in 14 young women depleted by low dietary iron intake and by phlebotomy, and repleted with non-heme iron in the diet. During iron repletion, the iron status indices of hemoglobin, hematocrit and zinc protoporphyrin positively responded to ascorbic acid (1500 mg/d). Chronic ascorbic acid supplementation did not affect absorption of an isotopic tracer dose of iron if it was not fed at the same meal as the iron.

o Effect of Glucose on Calcium Absorption in Elderly

A positive dose-response relationship between orally administered glucose (up to 40g) and fractional calcium absorption has been observed. In those subjects who responded, 40g of glucose enhanced calcium bioavailability by approximately 50 percent. The effect of milk and the milk sugar, lactose, on zinc absorption in lactose tolerant and intolerant postmenopausal women also was studied. Lactose had no effect on zinc bioavailability in these women, but milk inhibited zinc absorption.

o Bioavailability of Zinc and Selenium from Wheat

A study was conducted to determine the availability of zinc and selenium from wheat, using radioactive minerals as tracers. Rats were fed wheat grain either intrinsically labeled (added to wheat plant during grain formation) or extrinsically labeled (added to ground wheat) with radioactive zinc and radioactive selenium to determine the bioavailability of and interactions between zinc and selenium in natural foods. Zinc bioavailability was higher from extrinsically (64 percent) than from intrinsically labeled wheat (46 percent). Selenium bioavailability was similar in intrinsically (43 percent) and extrinsically (41 percent) labeled wheat. In zinc-depleted rats, absorption of zinc decreased with increased intake of selenium. In zinc-adequate rats, absorption of selenium decreased with increased intake of zinc. Results indicate that interactions may occur between natural forms of zinc and selenium at concentrations normally encountered in foods.

o Influence of Wheat Bran in Bioavailability of Dietary Vitamin E

The effect of wheat bran of distinct particle sizes (0.3 to 1.29 mm) on the bioavailability of vitamins A and E and on cholesterol metabolism was investigated. In a rat study, the bioavailability of vitamin E, but not that of vitamin A, was significantly impaired by 20 percent wheat bran. Wheat bran had no effect on plasma cholesterol. The results suggest that diets which contain high levels of wheat bran may require supplementation with vitamin E.

o Mineral Bioavailability from Soybean Hulls and Corn Bran

Soybean hull has a high iron content and a study has been completed demonstrating that the iron is present in both ferrous and ferric forms. The ferrous form is nutritionally available, making soy hulls a good source of bioavailable iron. The ratio of ferrous to ferric iron is dependent upon soybean variety and ranges widely.

The feasibility of using energy-dispersive x-ray analysis to quantitatively measure sodium, calcium, potassium, phosphorous, and sulfur in corn bran retrieved from the gastrointestinal tract of pigs has been demonstrated also. Contents of these five elements in bran retrieved from the stomach, ileum, or rectum was never less than in the bran prior to ingestion, indicating that corn bran is not a nutritional source of these elements.

o Bioavailability of Zinc from Beef in Humans

Beef is one of the best sources of zinc in the United States diet. However, the absorption of zinc from beef by humans has not been extensively studied. Therefore, a study was done to measure absorption of zinc from beef and to

find out if absorption could be measured by adding a zinc tracer to a beef-containing meal rather than by incorporating the tracer into a live animal. Volunteers were fed beef with a bun, potatoes, and a milkshake with the tracer added either intrinsically (to the steer) or extrinsically (to ground beef). About 23 percent of the zinc was absorbed, and the absorption of the two tracers was the same. Zinc absorption from this meal was much less than the 40 percent normally assumed.

4. Other Studies

o Aluminum Uptake in Women

Aluminum toxicity has been suggested to be partly responsible for some human disorders including Alzheimer's disease, amyotrophic lateral sclerosis and parkinsonism with dementia. Individuals using aluminum-containing antacids or buffered aspirin can consume large amounts of aluminum daily. Aluminum from these sources are generally poorly absorbed from the gut; however, animal studies suggest that low calcium and magnesium intakes might enhance aluminum absorption. Thus, the effect of calcium intakes of 600 mg/day (RDA-800 mg/day) and magnesium intakes of 116 mg/day (RDA-300 mg/day) on the appearance of aluminum in urine and blood after feeding 1000 mg aluminum/day to postmenopausal women was determined. The feeding of high dietary aluminum, even in the presence of low magnesium and calcium, did not affect the urinary excretion of aluminum. But high dietary aluminum tended to increase plasma aluminum and low dietary magnesium and calcium did markedly affect aluminum absorption. The finding that dietary aluminum elevated serum aluminum in some women suggests the need for further studies on the oral exposure to pharmaceutical amounts of aluminum.

o Stable Isotope Enrichment of Grains

Wheat, rice, corn, sorghum, and soybeans grown in experimental fields have been exposed to carbon dioxide containing ^{13}C (the stable isotope of carbon) during the grain-filling portion of each crop's life cycle. The stable isotope of carbon was assimilated by photosynthesis and, after labeling, the plants were grown to maturity, harvested by hand, and the grain separated from the straw by threshing. The efficiency of label incorporation into grain ranged from 51 percent for rice to only 3 percent for soybean. Portions of the rice have been processed into infant cereal by a commercial infant food manufacturer and are being applied in studies of carbohydrate utilization. In addition to grains, silage and other sources of plant fiber enriched in ^{13}C were recovered for further studies. The stable isotope is non-radioactive and can be used safely as a metabolic tracer even in studies with pregnant women and young infants.

D. Food and Nutrition Monitoring Research

Food consumption by Americans is monitored and their diets are assessed for nutrient content as part of the National Nutrition Monitoring System (NNMS). The five major NNMS categories are health and nutrition status measurements, food consumption measurements, food composition measurements, dietary knowledge and attitude assessment, and food supply determination. USDA has a long history and a prominent role in three: food composition measurement (section C), food supply determinants (this section), and food consumption measurements (this section). With the launching of the followup Diet, Health, Knowledge Survey with respondents from the 1989 Continuing Survey of Food Intakes by Individuals, USDA will have a prominent role in the area of dietary knowledge attitude assessment. Progress has been made towards the goals and plans for the NNMS as outlined in the Joint Operation Plan for the National Nutrition Monitoring System from 1987 to 1996 that was sent to Congress last year.

1. U.S. Food and Nutrient Supplies

HNIS estimates the supplies of food available for human consumption and the nutrient contribution of these supplies each year. This historical series of annual estimates dates back to 1909 and provides the only source of information on trends in food and nutrients available from the U.S. food supply since the beginning of the century. The last estimates reported were for the year 1985. Since the early part of the century, there have been many changes in the food supply. Of particular interest, year-round availability of an assortment of foods, new varieties, and enrichment have raised levels of seven vitamins--thiamin, riboflavin, niacin, vitamin B12, ascorbic acid, vitamin A, and vitamin E--from 1909-13 to 1985. The supply of vitamin B6 has remained about the same.

o United States and Soviet Union Food Supplies Compared

A joint study by HNIS and the Central Intelligence Agency estimated the levels and sources of nutrients in the Soviet food supply from 1965 to 1981 and compared it with those of the United States. Reports were published in USDA's National Food Review and in Gorbachev's Economic Plans, Volume 2, Study Papers submitted to the Joint Economic Committee, U.S. Congress. Although Soviet use of many foods (poultry, eggs, fruit, fish, vegetable fats, dairy products, vegetables, sugars and sweeteners, and meat) increased between 1965 and 1981, levels of protein, fat, cholesterol, calcium, iron, thiamin, riboflavin, vitamin A, and vitamin B-12 remained lower than American levels. On the other hand, carbohydrate and magnesium levels were higher in the Soviet food supply, reflecting greater use of grain products. They also had higher use of potatoes, whereas the United States had higher use of meat, poultry, and fruits. Protein supplied 12 percent of the food energy in both countries. Food energy supplied by fat increased from 24 to 28 percent in the Soviet food supply compared to 42 percent in the U.S. supply. Food energy supplied by carbohydrate declined from 64 to 60 in the Soviet food supply, but still topped the U.S. share of 46 percent.

2. Food Consumption Surveys (HNIS)

a. Research on Food Intake

Research to improve the efficiency of food consumption surveys and accuracy of the data are sponsored by HNIS as part of our continuing research program in dietary intake survey methodology. During the past decade, HNIS sponsored 12

major studies on survey methods to investigate diverse methodological elements of the data collection and analytical procedures. A number of findings were incorporated into the Continuing Survey of Food Intakes by Individuals (CSFII) 1985 and 1986 and the Nationwide Food Consumption Survey 1987-1988. In some cases, findings confirm retention of traditional methodology. To bring the results of this research to the nutrition and health communities, a comprehensive review of USDA-sponsored methodology studies has been developed for publication. This "one of a kind" resource book will describe the purpose and findings of key investigations since 1975, detail how findings have been incorporated in dietary intake surveys and discuss emerging needs. Publication is scheduled for early next year.

Findings from extramural research on CFSII data are presented.

o Research on Sources of Variance in Food Intake

C. Ritenbaugh, University of Arizona, studied sources of variance in food and nutrient intakes by women in CSFII-1985 data sets--basic 6 waves, basic 4 waves, and low-income 6 waves. Reported intakes per day differed between women who completed only 4, only 5, or all 6 waves of data collection. A decrease in reported intakes occurred between wave 1 and 2, but this "day 1 effect" was much smaller among women with children under 5 years. Variance ratios differed across strata of the population with Hispanics having nutrient intake variance ratios that were very different from those for whites or blacks.

o Alternate Methods for Estimating Nutrient Intakes

S. R. Johnson et al., Iowa State University, investigated development of alternative methods for estimating nutrient intake from food consumption survey data. A mathematical procedure was developed and applied for estimating the distribution of usual dietary intakes of women 19-50 years of age in CSFII 1985. Compared with the observed intake values, the estimated values for the 5 nutrients studied--energy, protein, calcium, iron, and vitamin C--had a lower variance and exhibited less skewness and kurtosis. In other words, the estimated distribution of intakes is more precise and is closer to a normal distribution than the observed distribution.

o Dietary Patterns of Smokers and Non-Smokers

F. Larkin, University of Michigan, studied dietary patterns of women smokers and nonsmokers using CSFII 1985 to assess the methodological importance and adequacy of survey questions about smoking practices. Results indicated that information about smoking practices was important in analysis of dietary intakes. After controlling for physical activity, health status, and demographic characteristics, women who smoked had significantly lower carbohydrate, fiber, vitamin C, thiamin, calcium, and iron intake per 1,000 calories. Consumption of fruits and vegetables was significantly lower and eggs, sugars, soft drinks, coffee, and alcoholic beverages was significantly higher for women smokers than nonsmokers. Survey questions about smoking practices in CSFII were determined to be adequate and important and were retained for the 1987-88 NFCS.

o Effect of Non-Response

Analysis of nonresponse in the CSFII 1986 was conducted to evaluate the impact on the data. Comparison of the distributions of survey participants across a variety of sociodemographic characteristics including geographic region,

urbanization, race, ethnic origin, employment status, and age to those of the general population of 19-50 year-old women in the United States provided comparable representation for each factor with the exception of age. Women 20-24 years old were slightly underrepresented in the survey sample. Evaluation of a follow-up survey of nonrespondents showed that relative to CSFII respondents, nonrespondents were similar to respondents in all variables studied. No difference was found regarding household size, race, ethnic origin, or participation in the Women, Infants, and Children Supplemental Feeding Program. The slight differences found by region, urbanization, and food sufficiency were adequately adjusted for by weights applied to the data. One exception was participation in the Food Stamp Program, which may either be over represented in the survey sample or under represented in the nonrespondent survey.

o Methodological Changes Assessed

Methodological and analytical efforts were carried out to facilitate evaluation of 1987-88 NFCS data in relation to methodological and data base changes occurring since 1977-78. The most intensive of these efforts is the Bridging Study NFCS 1977-78--CSFII--NFCS 1987-88. The purpose of this methodology study is to determine the extent to which differences in interview procedures, food coding procedures, and nutrient data bases used in NFCS 1977-78 from those used in NFCS 1987-88 resulted in differences in estimated quantities of food and nutrient intakes. Data collection has been completed on comparable samples of 350 women using procedures from both 1977 and 1987, and data processing is underway.

o Computer-Aided Interview Evaluated

Computer-aided personal interviewing (CAPI) was employed for the household portion of the 1987-88 NFCS. Laptop portable computers were used as an interviewing tool in data collection. This was the first large-scale national survey of its kind to use portable laptop computers as the primary means of collecting in-home personal interview data. Preliminary evaluation of CAPI provides potential to improve data accuracy and reduce data processing time, especially for household sociodemographic information. Special emphasis must be placed on the unique preparation and implementation issues, including selecting and training of interviewers particularly adept at computer use, developing protocols to ensure accurate entry of respondent-reported information and on-site editing of computerized interviews, establishing safeguards for data transmission to a centralized facility to ensure on-time, intact arrival, and implementing mechanisms to handle computer maintenance and breakdowns.

b. Collecting and Reporting of Survey Data (HNIS)

Survey activities were in four main areas: (1) preparation, documentation and release of public use data tapes and reporting of descriptive tabular results from the Continuing Survey of Food Intakes by Individuals in 1985 and 1986; (2) supporting technical aspects of data collection and processing and preparing for publication of results from the larger Nationwide Food Consumption Survey 1987-88, including household food use and food costs and food intakes at home and away by individuals; (3) developing plans for reinstating the CSFII in 1989 through 1996; and (4) planning for future activities conducted as part of the National Nutrition Monitoring System (NNMS).

o Continuing Survey of Food Intake by Individuals (CSFII)
1985 and 1986

The nine statistical reports in the CSFII series have been published, as well as numerous articles and papers describing food and nutrient intakes and dietary practices of national samples of women and men 19-50 years of age and 1-5 year-old children. All of the reports in the CSFII series have been published within 18 months after completion of annual data collections. Completion of the first two years of CSFII marks the successful implementation of the first nationwide dietary survey conducted year by year in this country to monitor changes in dietary habits. Among the findings from the 1985 low-income women's sample are that their dietary intakes were lower than the Recommended Dietary Allowances (RDA) for 7 of 15 nutrients examined--vitamin E, vitamin B-6, folacin, calcium, magnesium, iron, and zinc. These same nutrients were also lower than the RDA for all-income women. Low-income women and children who lived in households that participated in the Food Stamp Program had mean per day food and nutrient intakes that were generally the same or higher than those of women and children living in households that did not participate in the Food Stamp Program.

o Nationwide Food Consumption Survey (NFCS), 1987-88

Data collection of 6,000 households and household members in 1,118 sampling areas in the 48 conterminous States, which began April 1987, was completed in August 1988. The NFCS 1987-88 is the sixth decennial food consumption survey conducted by USDA since the first in 1935-36. Data collected includes detailed information on food used by the entire household during a 7-day period, on the price paid for each food bought, and on the food each member ate over 3 days, both at home and away. Questions were also asked about demographic and socioeconomic characteristics of households and household members. Sample selection, data collection, and data processing were conducted under contract by National Analysts, Division of Booz, Allen and Hamilton, Inc. according to HNIS specifications. As well as monitoring all aspects of sampling, data collection, and data processing, HNIS staff focused on advance preparations for timely reporting of results. Technical food information support files (food codes, volume-weight conversions, and nutrient data) for all the hundreds of different foods Americans consume were developed by HNIS for the contractor. A system to expeditiously respond to contractor requests for technical food-related information to update support files was implemented by HNIS to fill more than 4,000 requests. Data tape formats for processing and transmittal of data from the contractor to HNIS have been developed. Advance preparations for publication of results have been made to assist in timely release of results. Throughout the planning and conduct of the NFCS, cooperation and consultation has been encouraged by Federal agencies and professional organizations and associations. Over 100 individuals and groups contributed to or commented on the survey design and questionnaire. Coordination with NCHS was maintained to improve comparability and linkages between NFCS 1987-88 and NHANES III for more than 30 definitions, questions and assumptions. Training of interviewers and data reviewers was observed by HNIS staff, as well as staff from USDA's FNS and National Agricultural Statistical Services (NASS), and DHHS' NCHS. NASS are providing on-going consultative services in all statistical aspects of survey design, sampling, and analysis plans.

o Continuing Survey of Food Intake by Individuals (CSFII)
1989 through 1996

Plans have been developed for conducting the CSFII in each year from 1989 through 1996. This survey is designed to obtain 3 days of food intake data from all members of 1,500 households in the general population and an additional 750 households in the low-income population each year. This plan responds to the mandates of the Food Security Act of 1985 to collect data continuously and to include samples of low-income persons. Data from individual respondents are to be cumulative over time and will be combined to provide annual 2-to-5 year moving averages of dietary status of all sex-age groups. With each CSFII, a follow-up telephone survey is being planned in collaboration with USDA's Food Safety and Inspection Service and DHHS' Food and Drug Administration to interview consumers about their knowledge, attitudes, and perceptions concerning diet/health issues. This information will allow, for the first time, analyses to study links between diet-health knowledge and attitudes and dietary consumption patterns on a national basis.

o National Nutrition Monitoring System (NNMS) Plans

USDA's system of Nationwide Food Consumption Surveys, including NFCS and CSFII, are major components of the NNMS. The Operational Plan for NNMS from 1987 to 1996 highlights plans for monitoring activities into the mid-1990's. USDA's role involves the following:

- Annual estimates of the food and nutrient content of U.S. per capita food supplies.
- Continuation of food composition research and measurements by HNIS and ARS.
- Continuation of maintaining, updating, and documenting food composition data files and food coding systems for use in both NFCS and NHANES diet assessments.
- Reporting results from NFCS 1987-88 in published reports and public use data tapes.
- Conducting CSFII in each year from 1989 until 1997 when the next decennial NFCS will be conducted.
- CSFII followup telephone interview on consumers' knowledge, attitudes, and perceptions on diet/health issues.

o Dietary Assessment Research (HNIS, ARS)

USDA and DHHS jointly sponsored a Federal advisory committee which reported to the Congress on Nutrition Monitoring in the United States in 1986. Work is underway through a USDA/DHHS Joint Project Steering Committee for the next Report to Congress, planned for 1989. USDA and DHHS have jointly contracted with the Federation of American Societies for Experimental Biology (FASEB) to prepare the scientific basis and review for the report. FASEB has formed an expert panel on nutrition monitoring with representatives from a variety of disciplines. The scope and emphasis of the report will include an update on the dietary and nutritional status of the U.S. population since release of the first report in 1986 and will feature data from CSFII. An indepth analysis of two specific topics--nutritional factors in cardiovascular disease and

reassessment of iron nutriture--will also be included in the report. HNIS has provided FASEB with extensive special tabular analyses of CSFII 1985 and 1986 data.

3. Determinants of Dietary Status Research (HNIS)

Research projects conducted through cooperative agreements with colleges and universities have analyzed CSFII 1985 data to determine factors that influence dietary status. Findings from these investigations include:

o Factors Identified Which Are Related to Selected Nutrient Intakes

B. M. Popin, et al., University of North Carolina, identified factors which help explain changing food consumption patterns over the course of one year and over longer periods of time. Data used were the NFCS 1977-78 and the CSFII 1985 and 1986. The results provide strong evidence that a two-step decision making process is involved in food consumption whereby persons first decide whether or not to consume a specific food and then, as an independent decision, how much to consume. The single greatest factor associated with changing food consumption behavior between 1977 and 1985 was the educational level of the female head of household. Higher educational levels were associated with lower consumption of red meat and higher consumption of high fiber breads. Results of longitudinal analysis of the CSFII 1985 and 1986 data indicate a much larger ratio of inter-individual to intra-individual variability than has been shown in other studies. Season, weekend, and receiving food stamps are important variables in explaining an individual's changing food consumption over one year.

o Socioeconomic Factors and Eating Patterns

P. S. Haines, et al., University of North Carolina, studied the relationship between socioeconomic characteristics of adult women, their eating patterns, and the nutritional consequences of their patterns. They further identified trends in eating patterns between 1977 and 1985 and changes in the socioeconomic determinants of those patterns using the NFCS 1977-78 and the CSFII 1985. Women were classified into eating patterns based on the percent of energy consumed at each of eight locations--food brought into the home but consumed elsewhere, restaurant, cafeteria, fast food, vending machines, guest at someone else's home, and some other place. The number of women who consumed all food at home over a three-day period declined from 36 to 12 percent between 1977 and 1985. In 1985, the largest group of women, representing 35 percent of the sample and up slightly from 1977-78, was a group who consumed most but not all of their food energy from home. In 1985, there were marked increases in the percent of women classified into the four restaurant and fast food eating patterns--a total of 40 percent. The most important determinants of eating pattern selection and shifts included employment status and education of the female head of household, age, poverty level, and household size. Eating patterns helped to explain the variability in dietary intakes. In general, away from home eating patterns were associated with greater energy and fat intakes and lower nutrient densities, especially for sodium, cholesterol, dietary fiber, calcium, folacin, and vitamin C.

- o Socioeconomic and Health Risk Factors

G. Harrison, University of Arizona, examined both nutrient levels and food choices related to dietary guideline recommendations from CSFII all-income sample of women age 19 to 50. Independent variables included both sociodemographic variables and health-related variables such as smoking behavior. The analysis identified several sets of nutrients (nutrients from fruits and vegetables and nutrients from animal products) which varied independently of each other. These nutrient sets differed for some subsets of the population such as smokers and non-smokers. Health-related factors were also associated with intakes of some nutrients. Smoking was predictive of low intakes of vitamin A and protein. Alcohol use was positively associated with vitamin A and iron but negatively associated with vitamin B-12 intake. Vegetarianism was associated with lower intakes of protein, vitamin B-12 and zinc, and being on a weight loss diet negatively affected vitamin B-12 and zinc intakes.

- o Household Food Use Studied

Three cooperative agreements were awarded to analyze data from the household portion of NFCS 1987-88 to determine factors affecting household food use and nutrient levels. This research involves 7 days of food use and food cost data by households for the general and low-income populations in NFCS 1987-88 with comparisons to NFCS 1977-78. HNIS staff conducted a 2-day orientation conference for investigators, and HNIS scientists are working cooperatively with investigators to assure maximum coordination among investigators and usefulness of results to USDA and HNIS. Findings from these investigations will be reported at scientific meetings and published in reference journals.

- o Factors Identified Which Are Related to Low Nutrient Intakes

In-depth analysis was conducted by HNIS scientists on a number of key nutrients--dietary fiber, total fat, calcium, iron, and vitamin B-6--using CSFII 1985 data. Multiple logistic regression was employed to determine whether the likelihood that an individual's intake for a given nutrient being high or low can be statistically associated with selected demographic and socioeconomic characteristics while minimizing confounding effects. For example, higher iron intakes by women were associated with being a race other than white or black, living alone, having no male household head, having previously smoked, reporting number of days in which intake was less than usual, and being pregnant. Results were presented at national scientific meetings and provided for use in the second report of NNMS to Congress in 1989.

4. Nutritional Status Assessment Research

- o Vitamin C Status in the Elderly

As part of a nutritional status survey conducted by the ARS-USDA Human Nutrition Research Center on Aging at Tufts University, 677 Boston elderly (aged 60 to 98 years) were examined regarding the relationship among their intake of vitamin C, their plasma ascorbic acid levels, and selected biochemical markers of nutritional status. Only 6 percent of the males and 3 percent of the females were found to have less than adequate levels of plasma ascorbic acid. At all levels of intake, females were observed to have

higher plasma ascorbic acid levels than males. Use of vitamin C supplements was associated with improved biochemical status of vitamin C, B-2, E and folate in females after controlling for age and intake of the specific nutrient. Through a better understanding of the nutritional status of elderly Americans and the effects of vitamin supplementation on nutrient blood levels, policies can be developed to better serve their health needs.

o Selenium Status Assessment Method

Selenium (Se) is an essential trace nutrient for animals and humans. Se is also a very toxic element that occurs naturally in the soil. There is a need for rapid and simple methods of Se analysis to meet the demands for nutritional status assessment of populations and for environmental monitoring of Se contamination. Available methods are inadequate to meet these needs due to their requirement for expensive, specialized equipment or to their long, labor-intensive manual procedures. Work was undertaken, therefore, to adapt the catalytic Se assay previously developed to measure Se in biological materials. This has resulted in an entirely new method that reduces the labor required by about one-half and eliminates the need for specialized equipment. The new method is as sensitive as previous methods but is much more resistant to interferences from foreign substances and will eliminate some of the inaccuracies of current methods. The reductions in manual labor and the ease with which the catalytic method can be automated will make it a useful method for large-scale population surveys and environmental monitoring.

o Improved Assay for Assessing Vitamin A Status

Retinol binding protein (RBP) is the major carrier of vitamin A from its storage site in the liver to body tissues. It usually circulates in a 1:1 complex with transthyretin, but a significant fraction of RBP remains free in blood. It has been suggested that free RBP is a better indicator of vitamin A status than total RBP. A simple HPLC method is described which separates and quantitates both free RBP, and RBP bound to transthyretin. This assay has major advantages over the immunological methods currently used to measure RBP, since it is not species specific, is faster and more accurate, and measures free- and transthyretin-bound RBP separately instead of the total RBP as measured by immunological methods. Free RBP correlates to serum vitamin A better than total RBP or transthyretin bound-RBP in normal humans.

o Manganese Assay for Blood

Manganese is a trace mineral necessary for human and animal metabolism. It is present in very small amounts (parts-per-billion, ppb) in biological tissues such as blood and plasma. A reliable method is needed for its determination. The most sensitive analytical chemistry methods of measurement are cumbersome. Many compounds interfere with the analysis of manganese. Hence, a new method has been developed for determination of manganese in blood. This new method incorporates a background correction instrument and special sample preparation procedures. This method is very sensitive, relatively inexpensive and corrects for interfering compounds. Our results compare well with the published results of the National Bureau of Standards for reference standards.

o Assessment of Copper and Iron Status

A method for determining cytochrome c oxidase in platelets and white cells was tested using copper deficient rats or women fed diets marginal in copper.

Findings indicate that platelet cytochrome c oxidase activity may be a good indicator of copper nutriture; it is more sensitive to copper status than plasma copper or ceruloplasmin. Platelet size seemed to be larger in copper deficient, and smaller in zinc deficient, than in control animals. Methods for assessing iron status were evaluated in women depleted, then repleted, with iron. Findings confirmed that serum ferritin and transferrin iron saturation are sensitive to iron status. Zinc protoporphyrin was relatively insensitive to iron depletion.

o Measurement of Body Composition

Because the quantitation of total body fat is requisite in the nutritional assessment of man, numerous techniques have been developed to make such estimates. Two approaches are the measurements of skinfold thicknesses and the isotope-dilution technique. Skinfold thickness measurements are made easily with skinfold calipers; body fat is then calculated from body densities derived from the measurements. Deuterium and oxygen-18 are stable isotopes used to measure total body fat in normal adults. After ingestion of the isotopically-labeled water and its incorporation into body water, the label can be measured in plasma, urine, and saliva. A comparison of the two techniques was conducted which indicated that both methods are suitable and appropriate for body fat estimation in field studies, but the isotope dilution method provides more precise body fat estimates. Other studies also revealed that the isotope dilution method and anthropometric measurements provided similar estimates of body fat, lean tissue and body water in lactating women, when dynamic changes occur in the body as it reverts to its prepregnancy state.

Total body electrical conductivity (TOBEC) also has been introduced as a rapid, safe, and noninvasive method to estimate body composition. The adult TOBEC instrument was used to estimate total body water as determined by standard dilution techniques using stable isotopes. The adult TOBEC instrument was found to provide a suitable estimate of total body water. Calibration curves for the infant TOBEC were derived from miniature piglets for total body water and fat-free mass. Estimates of fat-free mass, fat, and total body water on healthy infants, 2 to 12 weeks old, from the calibration curves were in good agreement with those estimated from anthropometric indices and references body composition values.

Also, the electronic components of the acoustic plethysmograph for infant body volume measurements has been improved. Body volumes of infant miniature piglets measured by the acoustic method agree closely with those calculated from carcass analysis in which body volume is the sum of the volumes of total body water, fat, protein, and minerals. Fat free mass computed from densitometry using a four-compartment model and body volume measurements from the acoustic method agreed with results obtained from carcass analysis.

o Bioelectrical Impedance Measurements of Body Water

Water, the largest single component of the body, and its distribution in the body are important measures of nutritional status that are difficult to assess routinely. Traditional methods require isotopes and costly analytical equipment. An alternative is the application of bioelectrical impedance analysis. A method has been developed using four electrodes and a single signal frequency yields impedance variables that are useful predictors of total body water and corrected bromide space, an index of extracellular fluid volume. In a sample of 110 females and males, equations were developed and

tested to predict body water and bromide space. One impedance variable, height² resistance, was the best predictor of body water and bromide space. These results indicate that specific impedance values are useful predictors of body water compartments and the bioelectrical impedance method estimates total body water (TBW). Multiple regression analysis on the data of Black and Caucasian subjects combined, showed that race, offered as a separate independent variable, improved the correlation. It was concluded that bioelectrical impedance analysis may be valuable in the assessment of body composition in Blacks although a small underestimation of TBW can be found using equations from Caucasians.

Comparison of skinfold ratios between Blacks and Caucasians revealed lower triceps/subscapular and thigh/subscapular ratios in females and lower suprailiac/subscapular ratios in Black males and females. It is concluded that Blacks may have more deep and upper body fat deposition. The differences in fat patterning between Blacks and Caucasians have implications for the use of these ratios in epidemiological studies of the relationship between fat patterning and morbidity and mortality.

E. Food and Nutrition Information and Education Research

This research includes studies of dietary practices, food consumption patterns and their determinants (some described above) as well as studies of methods and strategies for informing and educating consumers and professionals who serve them about nutrition, health, and dietary practices. Research efforts are directed at questions about appropriate dietary guidelines for the public, about information needed to help the public understand and meet the guidelines, and about methods and techniques most appropriate and effective for communicating this information.

1. Establishing Dietary Guidance Policy (HNIS)

o Uses of Dietary Guidelines Studied

In support of the Dietary Guidelines for Americans, HNIS and ES jointly conducted a study to document and analyze ways that over 300 agencies, organizations, and businesses nationwide have used the Dietary Guidelines bulletin. Both the direct use of the concepts expressed in the bulletin and the bulletin itself were studied. Local community educators and nutrition/health professionals were interviewed, and Dietary Guidelines-related educational materials they developed were reviewed. Results will provide information for use in developing future bulletins.

o Effectiveness of Minibulletins Determined

A nutrition education research study is currently underway to evaluate comprehension and use of seven small bulletins, one for each of the Dietary Guidelines released under the title "Dietary Guidelines and Your Diet". The target audience of these bulletins is household food managers. Qualitative evaluation techniques, including concept mapping, cognitive responses, and self-reported food behavior change, are being used to assess understanding and use of the information. Results will identify content features that are effective in presenting information that can be used in future print materials and in guiding appropriate use of current materials, as well as those features which may need revision to improve their usefulness to the public.

o Practical Assessment System Devised

Dietary guidance to the public that includes quantitative standards or criteria must be made with an objective understanding of the impact that it will have on the total diet of the population. A unique computerized modeling system was developed to assess the practicality of implementing quantitative dietary recommendations in food guidance for a total diet. The Practicality Assessment System (PAS) objectively and quantitatively measures the type and extent of change that would be needed from existing food consumption patterns in order to meet quantitative nutritional criteria. The PAS uses food consumption data from USDA's system of Nationwide Food Consumption Surveys as the basis for a quadratic-programming analysis of minimal changes of consumption required to reach nutritional criteria. The system is useful to groups formulating or implementing dietary recommendations, and is used by HNIS to identify areas for emphasis in food guidance. It has been presented to national scientific groups and to the staff of the National Academy of Sciences, Food and Nutrition Board Committee on Dietary Guidelines Implementation.

2. Food and Nutrition Materials (HNIS)

Most materials developed in 1988 interpret concepts in the Dietary Guidelines and results from USDA research on food composition, food selection, handling and storage, and food money management. Target audiences are groups of food and nutrition professionals, such as home economics teachers, Extension agents, and public health professionals who work with the general public, low-income groups, and consumers with special interest in food and nutrition. The following are examples of materials developed and/or released in 1988.

o Dietary Guidelines Teaching Kit

A "Dietary Guidelines Teaching Kit" for use in teaching Dietary Guidelines concepts to home economics students in junior and senior high schools was released. The Kit has been used extensively in in-service training of home economics teachers in nearly one-third of the States throughout the country. It contains the Dietary Guidelines bulletin, mini-bulletins providing information to assist people to implement each of the seven Guidelines, and a "Home Economics Teachers' Guide." The guide was developed in collaboration with a panel of educators experienced in using nutrition education materials at the junior/senior high school level. Copies of the Kit are available free of charge to home economics teachers.

o Bulletins on Food Related Activities

A second set of four small bulletins was developed to help the public use the Guidelines in specific food-related activities--preparing food and planning menus, shopping for food and making meals in minutes, eating better when eating out, and making bag lunches and snacks and desserts. The bulletins are designed in a magazine-style format with color photography, illustrations, charts, and recipes. A consumer marketing firm was employed to develop the design treatment and to evaluate the material through qualitative methods such as focus group and intercept message testing. Release of the bulletins is planned for early 1989.

o Cost of Food

The cost of food at home in food plans at four cost levels--thrifty, low-cost, moderate-cost, and liberal--was estimated and released monthly in press releases and other formats. The cost of food in the thrifty food plan for the 4-person household, which is used by the Department in setting benefits for the Food Stamp Program, increased 2.7 percent between June 1987 and June 1988.

o Dietary Analysis Program

A dietary analysis software program for use on the personal computer, developed in cooperation with ES, was revised based on pilot-testing by consumers and updated to include the 1987-88 NFCS data base. The program analyzes up to 3 days of food intake for calories and 28 nutrients and food components and shows results on the screen or in printed copy. The USDA program is an educational tool for use by ES clients and other consumers to quickly analyze their diets and assess the effects of changes to their particular diet. The software is available for purchase through the National Technical Information Service.

F. Research on Government Policies and Socioeconomic Factors

1. Research Initiated

o Alternative Crops for Kentucky Farmers Studied

In cooperation with the Kentucky State Department of Agriculture, the University of Kentucky, and the Northern Kentucky Area Development District, the AMS began investigating the possibility of establishing farmers market facilities in Northern Kentucky. The study includes an analysis of needs and feasibility of building facilities to cool, wash, grade, and pack fresh fruits and vegetables and other products for the wholesale and retail market as a means of helping farmers in the area increase fresh production. Tobacco farmers and others have experienced declining income in recent years and are looking for alternative crops to augment their income. Some of these farmers and agribusiness leaders think that local fresh produce marketing opportunities exist and with good handling and marketing facilities, farmers can increase both production and sales.

2. Research Highlights

o Breastfeeding Promotion Study and Demonstration

Federal requirements for the Supplemental Food Program for Women, Infants and Children (WIC) include provisions to encourage breastfeeding. Because little is known about the most effective methods to promote breastfeeding in the WIC populations, the Food and Nutrition Service (FNS) is conducting the WIC Breastfeeding Promotion Study and Demonstration in FY 1987-89. The purpose of this study is to identify, evaluate, and demonstrate education models for effective breastfeeding promotion. These models will be used to provide technical assistance to State and local WIC agencies in their efforts to increase the proportion of WIC women who breastfeed.

The first three of four phases constituting the project have been completed. To identify breastfeeding promotion approaches in WIC programs, four major data collection activities were undertaken in Phase I. Phase II involved the analysis, synthesis, and documentation of data collected in Phase I. Phase III involved the creation of study report that describes the study design and data collection and draws upon study findings and experience to make recommendations for Phase IV.

Phase IV will involve the demonstration of breastfeeding promotion approaches at seven WIC local agencies in FY 1988-89. A major resource for the Phase IV demonstration is the publication produced in Phase II entitled Promoting Breastfeeding in WIC: A Compendium of Practical Approaches. The purpose of the demonstration is to obtain information about startup and maintenance of breastfeeding promotion models, information about breastfeeding incidence and duration, and information on barriers to breastfeeding and attempts to overcome them.

- o Analysis of the Dietary Impact of FNS Programs

FNS is analyzing data from USDA's Continuing Survey of Food Intakes by Individuals to assess the impact FNS' programs have on the dietary intake and food expenditure patterns of participants. In addition to studying direct effects on dietary intake, FNS is interested in learning of any indirect effect on a non-participating household member resulting from someone in the household participating in an FNS program. Analyses will also include examining participants' and non-participants' at-home and away-from-home food expenditure patterns.

- o The Supplemental Food Program for Women, Infants and Children (WIC) Analytic Research Projects

This Food and Nutrition Service (FNS) research focuses on a number of specific and ad hoc policy relevant analyses using data primarily from the WIC Participant Characteristics Study and the National WIC Evaluation. This research should expand present knowledge about the effectiveness of the WIC Program and provide more insight on program and participant characteristics. Examples of topics to be examined are characteristics of WIC households, food consumption patterns of WIC participants, and the relationships between participant and agency characteristics and the early enrollment of pregnant women.

III. NUTRITION EDUCATION AND INFORMATION PROGRAMS

The Human Nutrition Information Service coordinates Federal dietary guidance policy, develops research-based dietary guidance materials for the general public, and reports results from its research in food composition, food consumption, and nutrition education to professionals.

A. USDA's Responsibility That the Federal Government "Speaks With One Voice" When Issuing Dietary Guidance

1. Promotion of the Guidelines

Copies of "Nutrition and Your Health: Dietary Guidelines for Americans," second edition, published by USDA and DHHS in 1985, continues to be available through the Consumer Information Center (CIC). The bulletin continues to be one of the most frequently requested publications from CIC. Also offered are camera-ready copies of the bulletin for reproduction by others. ES and HNIS are conducting a study of users and uses of the bulletin and the concepts it presents.

2. Keeping Guidelines Current

USDA and DHHS are re-establishing a Federal Dietary Guidelines Advisory Committee. HNIS is the lead agency within USDA. Suggestions for advisory committee members have been requested from national scientific groups as well as through a Federal Register Notice. The committee will review recent scientific evidence on diet/health relationships and determine if revision is necessary. If the committee deems revision is needed, they will recommend specific changes to the Secretaries of USDA and DHHS. These recommendations will be used by the two Departments to prepare a third edition of the Guidelines to be issued in the early 1990's.

3. Supplemental Information Provided

Additional HNIS materials devoted to helping put the Guidelines into practice include a Home Economics Teachers' Guide that promotes the use of the Guidelines with junior and senior high school home economics students. Also, a second set of four "minibulletins" using the Dietary Guidelines together in specific food-related activities--preparing foods and planning menus, making bag lunches and snacks and desserts, shopping for food and making meals in minutes, and eating better when eating out--was developed and will be published in early 1989.

4. Uniformity Within USDA

The Dietary Guidance Working Group of the Subcommittee for Human Nutrition, initiated in 1986, is responsible for reviewing all USDA publications and materials that contain dietary guidance information to help ensure that they accurately reflect USDA's food and nutrition policy as presented in the Dietary Guidelines for Americans and in the Secretary's Statement of USDA's Food and Nutrition Policy that they are supported by research-based knowledge, that they are objective in presentation, and that they are supported across all agencies of USDA. The group is chaired by HNIS and includes representatives from nine USDA agencies--AMS, ARS, ERS, ES, FNIC, FNS, FSIS,

HNIS and OGPA--and a liaison member from the DHHS. The Group developed a set of 10 "Principles of Dietary Guidance for the General Public" to help authors produce dietary guidance materials that accurately reflect the Dietary Guidelines concepts.

5. Uniformity Among Departments

The Department continues to work with other agencies, especially DHHS in promoting uniformity of dietary guidance messages. For example, HNIS is represented on a DHHS Subcommittee on Dietary Guidance; on the Coordinating Committee for the National Cholesterol Education Program sponsored by the National Heart, Lung and Blood Institute; and on the Nutrition Objectives Working Group of the DHHS Year 2000 Health Objectives Committee. HNIS and DHHS' National Institute on Aging have initiated a joint effort to develop a bulletin on the nutrition needs of the elderly emphasizing the Dietary Guidelines.

6. Coordination With Private Sectors

HNIS has described its unique computer modeling system--the Practicality Assessment System--for assessing change in current food consumption patterns to meet quantitative dietary recommendations to various scientific organizations, including the staff of the Food and Nutrition Board, National Academy of Sciences and the American Dietetic Association. This system is intended for use with other professional groups to solve mutual research problems. USDA has interpreted its research and dietary guidance policies for numerous commodity and trade associations who strive to develop products that meet consumer demands which are increasingly related to nutritional health issues. The American Red Cross 12-hour nutrition course, developed cooperatively with HNIS and ES, continues to be used in Red Cross Chapters nationwide to interpret the Dietary Guideline concepts in practical, interesting ways. This course has been shown through extensive evaluation to be successful in improving knowledge and food selection behavior. A Nutrition Education Task Force composed of government and industry representatives continues to meet quarterly under the direction of FDA with extensive participation by HNIS.

B. Programs Initiated or Expanded

1. On-Going Food and Nutrition Cooperative Extension Service Activities

Nutrition, diet and health programs continue to be a major program emphasis within the Cooperative Extension Service. Each year, approximately 10-12 million people of all age groups and income levels participate in these educational programs. Four to five times this many are reached through mass media efforts. Approximately two million phone calls requesting nutrition, diet and health information are answered annually. In addition, approximately one-third of all 4-H members have food and nutrition projects. All 50 States and five territories support programs in nutrition, diet and health. They constitute approximately 45 percent of Extension's county home economics programming.

Over the last year, two issues have been identified by the Cooperative Extension system as major priorities within the Improving Nutrition, Diet and Health Initiative. These are dietary practices related to lifestyle factors and health and confidence in the safety, quality and composition of the food supply. More emphasis will be placed on helping clientele implement the Dietary Guidelines and assisting special audiences such as mothers, infants, and children. Food safety programs will be expanded to not only include the traditional programs on safe food handling, but also to evaluate the risks and benefits of various food components and our food regulatory system. As always, the Dietary Guidelines in conjunction with research-based information serve as the bases for developing program content. Programs are designed to assist consumers in making sound decisions that can positively affect their quality of life.

2. Extension's Expanded Food and Nutrition Program (EFNEP)

This program which began in 1968, continues to be a very effective program for the target audience of low-income families with small children to acquire knowledge, skills, attitudes, and changed behavior necessary to improve their diet and use meager resources well. During FY 1988, EFNEP focuses attention on the effectiveness of various delivery methods to increase learner skills and competencies. A number of small projects from the States were funded, each looking at different delivery methods and evaluation tools that could be used in increasing the effectiveness of the EFNEP program. Information gathered from these projects will be made available in 1989. EFNEP staff also spent a considerable amount of time in 1988 looking for ways to improve the EFNEP system for reporting data from the states about the participation levels and effectiveness of the EFNEP program. This effort will continue in 1989.

3. Computerized Dietary Analysis as an Educational Tool

Extension Service and the Human Nutrition Information Service have entered into a joint project to evaluate the cooperatively developed USDA's Dietary Analysis Program (DAP). USDA's DAP is a software package that analyzes dietary intakes for up to 3 days and provides information on 28 nutrients and food components. The nutrient database used by the software consists of the 850 most commonly consumed foods from HNIS's most up-to-date available nutrient values--the USDA Nutrient Database for the 1987/88 Nationwide Food Consumption Survey. This database can be updated as the nutrient values change, adding a dimension of accuracy not common to other dietary analysis software packages.

The purpose of the joint ES/HNIS evaluation project is to determine the best educational use of USDA's DAP. Eight States will be testing the software in various settings and with different audiences. Its use will be compared to other forms of program delivery to determine what impact individualized dietary evaluation has on audiences that are involved in nutrition education programs.

4. Cooperative Meat Education Project

USDA Extension Service is involved in an innovative cooperative program development process to provide consumers with the skills and knowledge needed to incorporate lean meat into a well-balanced, varied diet. Titled "The Consumer's Choice--Lean Meat" the program includes information on livestock production and food safety concerns, proper selection, low fat preparation, health and nutrition and the availability and use of convenience foods. The educational modules for the program are being developed by a multistate, multidisciplinary team of Meat Science and Food and Nutrition Specialists from Florida, Kansas, and Texas. In addition, an advisory committee consisting of representatives from the meat industry, health community, retail industry, and potential end-users has been formed to provide input and react to the program content. The Extension staff met with the advisory committee last October and developed program objectives and key concepts. These will serve as the basis for the modules being developed. If this program development process proves successful, it is hoped to use it as a model for a similar approach to other commodities including fish and seafood, poultry, grain and grain products, legumes, fruits and vegetables, dairy products, etc.

5. Risks and Benefits of Food Systems Explored

Recognizing that consumers are concerned about the safety and wholesomeness of our food, Extension Service has initiated a set of pilot studies to evaluate various methods of delivering risk/benefit education to consumers, producers, processors, food handlers, etc. The ultimate message of these educational programs will be that our food system cannot be entirely risk free, but that through a responsible, scientifically-based system of evaluating risks and benefits, risks can be minimized to provide us with a safe, nutritious, inexpensive, varied food supply.

Risk communication has always been a difficult educational problem. It is hoped that through the experiences provided by these pilot education projects, Extension will improve its capability to facilitate dialog and hence communication and understanding between various members of the food chain. Topics selected by the pilot project States include pesticide use, use of growth promotents in cattle, seafood safety, Listeria contamination, etc. Each program will be developed by an interdisciplinary team of State Specialists and other university faculty.

6. Dairy Nutrition Education Project

ES-USDA has worked with the National Dairy Promotion and Research Board for the development of educational resources for audiences of two age groups: people over 50 years old and youth between 10-15 years of age. A multidisciplinary team approach was adopted for the development process. Teams of Food and Nutrition Extension Specialists, 4H-Youth Specialists and field staff from 10 different states provided inputs at the initial and subsequent stages of the development. In addition, inputs from the Dairy

Board's Technical Review group and end-user organizations such as the Extension Homemakers' Club and Future Homemakers of America were incorporated prior to the distribution of materials via the Cooperative Extension System. These videotapes and supplementary materials emphasized the consumption of a variety of foods in moderation, exercise, and the role of dairy foods in the total diet.

7. Food Distribution Program on Indian Reservation

In 1985-86 a Food and Nutrition Service (FNS) task force reviewed the Food Distribution Program on Indian Reservation (FDPIR) regulations to make recommendations for improving the food package and expanding nutrition education efforts. The task force report summarized the results of the review and presented recommendations for modifying the food package and for improving the delivery of nutrition education to participants. Recommendations for improving the food package were implemented in FY 1987.

In FY 1988 FNS worked cooperatively with the Indian Health Service (IHS), DHHS; and the Food and Nutrition Information Center (FNIC), USDA to implement the following nutrition education recommendations in FDPIR:

- o expanded FNS' FY 1988 Interagency Agreement with FNIC to include services to FDPIR cooperators,
- o developed two short annotated bibliographies on related health and cultural topics,
- o developed and distributed a nutrition education directory of FDPIR contacts,
- o developed an IHS/FNS Memorandum of Agreement for Nutrition Education Technical Assistance,
- o developed a nutrition education resource guide, and
- o developed a FDPIR nutrition education exhibit for use by State and local agencies.

8. AMS Changes "USDA Good" to "USDA Select"

The beef grade "USDA Good" was renamed "USDA Select" effective November 23, 1987. USDA standards for quality beef grades describe such factors as the amount of fat, color, and texture of a cut of meat, indicating its tenderness, juiciness, and flavor.

In June 1986, Public Voice for Food and Health Policy--a non-profit consumer, research, education, and advocacy organization--petitioned the Department to amend the beef grade standards. Stating that the "Good" beef grade is leaner than "Prime" or "Choice" and "may not be less desirable, as the current name suggests, to persons who put a premium on nutrition," the petition asked USDA to change the name of the "Good" beef grade to a more positive grade name, such as "Select." AMS proposed the name change in the Federal Register of March 4, 1987. Some 170 comments were received and evaluated before USDA issued the final ruling.

9. AMS Requires More Fat Trim From Beef

The Institutional Meat Purchase Specifications (IMPS) for fresh beef were changed, effective January 1988, to require that more fat be trimmed from various cuts of beef than was allowed in the past. The external fat on portion cuts of beef (i.e., steaks) was reduced from 1/2-inch to 1/4-inch. For the first time, the term "practically free of fat" was quantified and now means that at least 75 percent of the lean is exposed on the surface of the cut.

IMPS are voluntary guidelines for cut definitions and trimming practices. The meat industry uses them to help standardize quality control procedures with regard to meat trimming practices. Wholesalers, the Department of Defense, and other institutional food buyers use IMPS to determine if they are receiving what they are paying for. If purchasers asked AMS to certify that procured products comply with the IMPS, the packer must follow the IMPS during production.

10. Food and Nutrition Information Center Expert/Advisory Systems

Staff at the National Agricultural Library have created small-scale microcomputer systems to mimic advisory work done by human experts, in this case subject specialists and reference librarians. These systems guide users to appropriate references -- books, articles, audiovisuals, etc. -- or, in some instances, to the answers to specific questions. Expert/advisory systems provide an opportunity to free the professional staff for more complex tasks.

Specifically, the Food and Nutrition Information Center has developed a prototype expert/advisory system (a) to demonstrate the usefulness of such systems in library reference work; (b) to illustrate the kinds of information that can be included in an expert system, and (c) to describe the services and resources of the Food and Nutrition Information Center.

11. New Bibliographies/Information Products

a. An FNIC-Sponsored seminar featuring Dr. Myron Winick was held at NAL. Dr. Winick offered a review of the scientific investigations that have examined the possible links between early eating habits and adult health problems such as obesity, heart disease, hypertension and cancer. The seminar was videotaped, entered into the NAL collection, and is available for loan. Two Special Reference Briefs entitled "Childhood Obesity" and "Childhood Antecedents to Adult Coronary Artery Diseases," were authored by Dr. Winick in cooperation with FNIC and are available on request.

b. "Nutrition Education Resource Guide for American Indians and Alaska Natives" is an annotated bibliography of culturally relevant nutrition education materials written by or for American Indians and Alaska Natives. Two Pathfinders--"Health Update on American Indians and Alaska Natives;" and "Understanding American Indian and Alaska Native Cultures"--were also developed to complement this bibliography. The Pathfinders are short annotated listings of selected books, journal articles, and audiovisual materials. The bibliography and Pathfinders were developed cooperatively by NAL, the Food and Nutrition Service, and the Indian Health Service, DHHS.

c. Two new Pathfinders have been prepared on the topic of food safety. The first, designed for food service audiences, addresses the safety of ready-prepared foods. The second presents food safety resources useful to educators.

d. An NAL Quick Bibliography, listing audiovisual in the FNIC collection on personnel supervision, was completed.

12. Other Ongoing Activities of the National Agricultural Library

a. An update of the publication "Promoting Nutrition through Education: A Resource Guide to the Nutrition Education and Training Program (NET)," will include food service training and nutrition education resources developed with NET funding support since 1984.

b. FNIC continues to provide comprehensive reference/research support and direct lending services to the U.S. Congress, Federal government agencies, and Libraries and information centers. Through an interagency agreement with the Food and Nutrition Service, USDA, user categories eligible for unrestricted services have been expanded to include cooperators with FNS programs. Others may obtain FNIC materials through interlibrary loan; comprehensive reference assistance is available on a cost recovery basis.

c. Updates of two NAL Quick Bibliographies were completed: "Infant Nutrition: Research and Reference Materials (1984-1987)," and "Diet, Race, and Ethnicity in the U.S.: Research and Reference Materials (1979-1987)."

d. Computerized database searches listing (a) management audiotapes and (b) audiovisuals on occupational and kitchen safety, were prepared.

e. The FNIC microcomputer software demonstration collection continues to expand, currently containing over 150 programs for dietary analysis, nutrition education, and food service management. Software is available for onsite preview by appointment only.

13. Public Service Campaign for Food Stamp Recipients

The Food and Nutrition Service (FNS) has contracted with the Ad Council to develop a public service campaign for Food Stamp recipients. The focus of this campaign is to promote the importance of good nutrition and its relationship to health. Through TV and radio public service announcements and print, transit and billboard advertising, the campaign positions the food stamp office as a place to receive the nutrition booklet. The booklet provides practical information on shopping, cooking, and eating habits for good health, as well as recipes. The campaign will begin in January 1989 and will run for one year.

14. Graduate Fellowships Grants Program Activities - 1988

The U.S. Department of Agriculture Food and Agricultural Sciences National Needs Graduate Fellowships Grants Program was initiated in 1984 specifically to attract academically outstanding scholars into advanced studies in the food

and agricultural sciences. The program provides 3 years of training for a doctoral student and 2 years for a master's student in one of the national needs shortage areas. The fellowships program has achieved a notable record and is proving to be an important part of the solution to the serious erosion of our scientific expertise. More than 400 fellows have been participants in this program to date, with 25 percent of the fellows in the national need area--Food Science/Human Nutrition.

CSRS/HEP activities related to the FY 1984 fellowships grants program in 1988 have included a national symposium honoring USDA Food and Agricultural National Needs Fellows that was held at the National Academy of Sciences April 18-19. The symposium entitled, FOCUS, 1988--Future Opportunities and Challenges Unique to Science, was jointly sponsored by the National Academy of Sciences and USDA. A Poster Exhibit was an integral part of FOCUS, 1988. The exhibit provided each fellow with an opportunity to display notable aspects of his or her research or program of study. The young men and women honored will be leaders among the next generation of food and agricultural scientists. They represent prestigious graduate departments at both land-grant and other universities in four disciplines: biotechnology; food science/human nutrition; food and agricultural marketing; and agricultural engineering.

Nutrition fellows were valuable participants in all of the above. Among the institutions they represented were Cornell University, Tufts University, University of California--Davis, University of Connecticut, University of Florida, University of Georgia, and the University of Massachusetts.

In FY 1987, almost \$2.8 million were available to fund the program. One-third of the funds were targeted toward Food Science/Human Nutrition and 57 requests for funding were submitted in this area. FY 1987 National Need Nutrition Grants were awarded to the University of California--Davis (\$192,000), Cornell University (\$96,000), University of Iowa (\$96,000), and University of Georgia (\$96,000). Project directors for these grants will have enrolled ten doctoral fellows in nutrition for 3 years of USDA support by December, 1988.

In FY 1988, almost \$2.8 million dollars was again available for funding the program. There were 62 proposals submitted in Food Science/Human Nutrition and FY 1988 National Need Nutrition Grants were awarded to the University of Florida (\$96,000), University of California--Davis (\$48,000), University of California--Berkeley (\$144,000), and the University of Chicago (\$48,000). During FY 1989, project directors at these institutions will select seven doctoral students for 3 years of support.

15. Food and Agricultural Education Information System (FAEIS)

Our office is pleased to announce that a new information system will soon be available which provides various statistical data on attributes of the U.S. food and agricultural sciences higher education system--students, faculty, graduates, programs, etc. The system, known as the Food and Agricultural Education Information System (FAEIS), will be available on Dialcom.

A broad array of information useful in planning and evaluating higher education in the food and agricultural sciences is collected by Federal and State agencies and by professional organizations. These data are often widely dispersed, difficult to obtain, summarized under incompatible taxonomies, or aggregated so as to confound interpretation. The intent of FAEIS is to

access, organize, and disseminate such data in a timely manner and, thus, allow policy-makers to better address the Nation's needs for educating Agricultural, Home Economics, Forestry, Natural Resources, Veterinary Medicine, and related scientists and professionals.

FAEIS has been jointly developed by the U.S. Department of Agriculture, Cooperative State Research Service, Higher Education Programs and Texas A&M University, College of Agriculture through a cooperative agreement. We are indebted to the outstanding leadership and technical assistance Texas A&M University has provided on this project.

IV. FUNDING LEVELS (1984-1989)

The expenditures for human nutrition research and human nutrition education and information by the several agencies in USDA for fiscal years 1984 through 1989 are summarized in Table 2. The Congressional appropriation for FY 1989 is also included. The total amount of human nutrition research support has increased from \$53.3 million in fiscal year 1984 to \$61.6 million in fiscal year 1989, an increase of 15.6 percent. During the same period, support for human nutrition education and information has increased from \$128.5 to \$146.0 million, an increase of 13.6 percent. The total support for human nutrition in the Congressional appropriation for FY 1989 is \$207.6 million or 14.2 percent more than was expended in FY 1984.

Table 3 shows the amount of human nutrition research support within the Department for this period by subject area categories and agency. Slightly over half of the human nutrition research effort is focused on determining nutrient requirements/health maintenance at all stages of life. One-sixth of the effort relates to the development of methods for measurement of nutritional status and collection of food consumption information. Approximately 1/6 of the funds are used to measure the content and bioavailability of nutrients in foods. The funds shown in the table do not include funds provided by the States or other sources and used in conjunction with those funds provided by the Cooperative State Research Service (CSRS).

Funds available for competitive research grants in human nutrition through CSRS were reduced in the appropriation from \$2.5 million in FY 1988 to \$1.0 million in FY 1989.

Table 4 presents a breakdown of human nutrition education and information expenditures and budgets by subject category for the fiscal years 1984 through 1989.

A summary of actual expenditures, estimated support and the Congressional appropriation is given in Table 5 for the five Human Nutrition Research Centers and other Laboratories or Centers of the Agricultural Research Service (ARS) for fiscal year 1984 through fiscal year 1989. The net figure refers to funds to the location, while the gross amount includes overhead costs.

The Center at Tufts University in Boston is operated by ARS as a government-owned, contract-operated (GOCO) facility. The Center at Baylor College of Medicine in Houston is operated by ARS through a cooperative agreement.

Human nutrition research support at ARS Regional Research Centers and other Laboratories is shown in Table 6. These studies help to assure that problems and opportunities in human nutrition are considered in research directly related to the quality of the food supply.

Table 2

U.S. DEPARTMENT OF AGRICULTURE
HUMAN NUTRITION RESEARCH, EDUCATION AND INFORMATION
SUPPORT (FY 84-89)

HUMAN NUTRITION RESEARCH
(\$ in Millions)

	FY 1984 <u>actual</u>	FY 1985 <u>actual</u>	FY 1986 <u>actual</u>	FY 1987 <u>actual</u>	FY 1988 <u>actual</u>	FY 1989 <u>estimate</u>
ARS	34.3	36.9	37.8	40.6	44.3	45.7
CSRS	7.6	7.3	7.5	7.5	7.7	6.9
HNIS	5.3	6.0	12.8	6.1	7.1	7.7
ERS	0.7	0.7	1.1	1.2	0.8	0.9
ENS	5.4	1.4	1.5	0.5	0.5	0.4
TOTAL	<u>53.3</u>	<u>52.3</u>	<u>60.8</u>	<u>55.9</u>	<u>60.4</u>	<u>61.6</u>

Human Nutrition Education and Information

ES	76.6	77.0	73.5	73.5	75.0	75.0
HNIS	0.7	0.7	1.2	0.7	1.2	1.1
ENS	50.5	55.0	57.6	60.4	65.5	69.3
FSIS	0.3	0.5	0.4	0.13	0.1	0.1
NAL	0.4	0.4	0.5	0.4	0.5	0.5
TOTAL	<u>128.5</u>	<u>133.6</u>	<u>133.2</u>	<u>135.1</u>	<u>142.3</u>	<u>146.0</u>

TOTAL RESEARCH,
EDUCATION AND
INFORMATION

181.8	185.9	194.0	191.0	202.7	207.6
-------	-------	-------	-------	-------	-------

Table 3

USDA NUTRITION RESEARCH PROGRAM SUPPORT (FY 84-89)
(\$ in Millions)

	<u>FY</u> <u>1984</u> <u>actual</u>	<u>FY</u> <u>1985</u> <u>actual</u>	<u>FY</u> <u>1986</u> <u>actual</u>	<u>FY</u> <u>1987</u> <u>actual</u>	<u>FY</u> <u>1988</u> <u>actual</u>	<u>FY</u> <u>1989</u> <u>estimate</u>
1. Nutrient Requirements/ Health Maintenance						
CSRS	4.0	4.6	3.9	4.6	4.2	4.1
ARS	<u>27.3</u>	<u>26.3</u>	<u>27.5</u>	<u>29.9</u>	<u>31.0</u>	<u>33.3</u>
Total	<u>31.3</u>	<u>30.9</u>	<u>31.4</u>	<u>34.5</u>	<u>35.2</u>	<u>37.4</u>
2. Nutritional Status/ Food Intake						
CSRS	2.1	1.4	1.7	1.3	1.8	1.4
ARS	0.6	2.3	3.1	3.9	3.9	4.0
HNIS	<u>2.6</u>	<u>3.2</u>	<u>9.9</u>	<u>3.2</u>	<u>3.9</u>	<u>4.8</u>
Total	<u>5.3</u>	<u>6.9</u>	<u>14.7</u>	<u>8.4</u>	<u>9.6</u>	<u>10.2</u>
3. Use of Food/Food Choices						
CSRS	0.2	0.3	0.2	0.2	0.2	0.2
HNIS	1.1	1.1	1.1	1.1	1.3	1.1
ERS	<u>0.4</u>	<u>0.4</u>	<u>0.8</u>	<u>0.9</u>	<u>0.7</u>	<u>0.8</u>
Total	<u>1.7</u>	<u>1.8</u>	<u>2.1</u>	<u>2.2</u>	<u>2.2</u>	<u>2.1</u>
4. Nutrient Composition/ Bioavailability						
CSRS	1.3	1.0	1.6	1.3	1.4	1.1
ARS	6.5	8.3	7.2	6.8	9.4	8.4
HNIS	<u>1.6</u>	<u>1.7</u>	<u>1.8</u>	<u>1.8</u>	<u>1.9</u>	<u>1.8</u>
Total	<u>9.4</u>	<u>11.0</u>	<u>10.6</u>	<u>9.9</u>	<u>12.7</u>	<u>11.3</u>
5. Nutritional Impacts of Programs						
CSRS	---	---	0.1	0.1	0.1	0.1
ERS	0.3	0.3	0.3	0.3	0.1	0.1
FNS	<u>5.4</u>	<u>1.4</u>	<u>1.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.4</u>
Total	<u>5.7</u>	<u>1.7</u>	<u>1.9</u>	<u>0.9</u>	<u>0.7</u>	<u>0.6</u>
TOTALS						
CSRS	7.6	7.3	7.5	7.5	7.7	6.9
ARS	34.3	36.9	37.8	40.6	44.3	45.7
HNIS	5.3	6.0	12.8	6.1	7.1	7.7
ERS	0.7	0.7	1.1	1.2	0.8	0.9
FNS	<u>5.4</u>	<u>1.4</u>	<u>1.5</u>	<u>0.5</u>	<u>0.5</u>	<u>0.4</u>
USDA Total Nutrition Research	<u>53.3</u>	<u>52.3</u>	<u>60.8</u>	<u>55.9</u>	<u>60.4</u>	<u>61.6</u>

Table 4

USDA FOOD AND NUTRITION EDUCATION AND INFORMATION SUPPORT (FY 84-89)
(\$ in Millions)

	FY 1984 <u>actual</u>	FY 1985 <u>actual</u>	FY 1986 <u>actual</u>	FY 1987 <u>actual</u>	FY 1988 <u>actual</u>	FY 1989 <u>estimate</u>
Extension Service ^{1/}						
Extension (Formula est.)	16.2	16.7	15.9	15.9	16.4	16.4
Expanded Food and Nutrition Education Program (EFNEP)	<u>60.4</u>	<u>60.3</u>	<u>57.6</u>	<u>57.6</u>	<u>58.6</u>	<u>58.6</u>
Total	<u>76.6</u>	<u>77.0</u>	<u>73.5</u>	<u>73.5</u>	<u>75.0</u>	<u>75.0</u>
National Agricultural Library						
Food, Nutrition and Human Ecology Staff	0.4	0.4	0.5	0.4	0.5	0.5
Human Nutrition Information Service						
Nutrition Education Division	0.7	0.7	1.2	0.7	1.2	1.1
Food and Nutrition Service ^{1/}						
Nutrition Education & Training Program (NET)	5.0	5.0	5.0	5.0	5.0	5.0
Special Supplemental Food Program for Women, Infants and Children (WIC) ^{2/}	<u>45.5</u>	<u>50.0</u>	<u>52.6</u>	<u>55.4</u>	<u>60.5</u>	<u>64.3</u>
Total	<u>50.5</u>	<u>55.0</u>	<u>57.6</u>	<u>60.4</u>	<u>65.5</u>	<u>69.3</u>
Food Safety and Inspection Service						
Nutrition Labeling	0.1	0.1	0.1	0.1	0.1	0.1
Nutrition and Sodium Information*	0.1	0.1	0.1	0.02	0.0	0.0
Sodium Monitoring Program*	<u>0.1</u>	<u>0.3</u>	<u>0.2</u>	<u>0.01</u>	<u>0.0</u>	<u>0.0</u>
Total	<u>0.3</u>	<u>0.5</u>	<u>0.4</u>	<u>0.13</u>	<u>0.1</u>	<u>0.1</u>
USDA Total Nutrition Education and Information	128.5	133.6	133.2	135.1	142.3	146.0

^{1/} Most funds are distributed to and managed by State agencies.

^{2/} Estimate of State administrative funds allocated for nutrition education.

*Programs discontinued

Table 5

AGRICULTURAL RESEARCH SERVICE
HUMAN NUTRITION RESEARCH SUPPORT (FY 1984-89)

Estimated Funds (In millions of dollars)							
		<u>FY 1984 actual</u>	<u>FY 1985 actual</u>	<u>FY 1986 actual</u>	<u>FY 1987 actual</u>	<u>FY 1988 actual</u>	<u>FY 1989 estimate</u>
BHNRC, Beltsville, MD	Gross	7.97	8.00	7.91	8.34	8.42	8.12
	Net	6.98	7.30	7.02	7.41	7.35	7.31
GFHNRC, Grand Forks, ND	Gross	5.72	6.19	6.36	6.66	7.11	7.03
	Net	5.33	5.57	5.64	5.92	6.32	6.33
HNRC, Boston, MA	Gross	9.59	11.35	11.75	12.76	13.68	14.06
	Net	9.12	10.79	11.16	12.12	12.99	13.35
CNRC, Houston, TX	Gross	3.27	3.59	4.43	5.43	7.65	9.07
	Net	2.96	3.23	3.93	4.88	6.99	8.34
WHNRC, San Francisco, CA	Gross	3.81	3.79	3.66	4.23	4.49	4.46
	Net	3.33	3.42	3.25	3.76	3.95	4.01
TOTAL, HN Centers	Gross	30.36	32.93	34.12	37.43	41.35	42.74
	Net	27.70	30.31	31.01	34.09	37.59	39.34
Other ARS HN Research	Gross	3.97	3.88	3.65	3.18	3.01	2.96
	Net	3.27	3.49	3.24	2.86	2.65	2.66
TOTAL, Human Nutrition	Gross	34.33	36.81	37.76	40.61	44.36	45.70
	Net	30.97	33.80	34.24	36.95	40.25	42.00

Table 6

AGRICULTURAL RESEARCH SERVICE

OTHER ARS HUMAN NUTRITION RESEARCH SUPPORT (FY 84-89)*
(In thousands of dollars)

		<u>FY</u> <u>1984</u> <u>actual</u>	<u>FY</u> <u>1985</u> <u>actual</u>	<u>FY</u> <u>1986</u> <u>actual</u>	<u>FY</u> <u>1987</u> <u>actual</u>	<u>FY</u> <u>1988</u> <u>actual</u>	<u>FY</u> <u>1989</u> <u>estimate</u>
Beltsville, MD	Gross	187.0	--	--	--	128.7	121.8
	Net	155.0	--	--	--	111.8	109.6
Ithaca, NY	Gross	305.0	551.5	601.3	750.9	765.0	755.4
	Net	246.7	496.6	533.5	675.9	676.0	679.7
Wyndmoor, PA	Gross	580.2	700.5	667.1	303.1	--	--
	Net	471.2	630.6	591.8	272.9	--	--
Peoria, IL	Gross	1,184.4	1,023.8	985.5	982.4	1,017.5	1,007.1
	Net	985.3	921.7	874.5	884.3	898.8	906.3
Albany, CA	Gross	1,412.2	1,007.9	959.2	712.7	653.8	493.0
	Net	1,161.3	907.5	851.0	641.5	576.3	443.6
Athens, GA	Gross	302.2	149.0	--	--	--	--
	Net	249.8	134.1	--	--	--	--
Hyattsville, MD	Gross	--	449.0	433.5	432.7	443.1	580.0
	Net	<u>--</u>	<u>404.2</u>	<u>384.6</u>	<u>389.5</u>	<u>391.0</u>	<u>521.9</u>
	Gross	3,971.0	3,881.7	3,646.6	3,181.8	3,008.1	2,957.3
	Net	3,269.3	3,494.7	3,235.6	2,864.1	2,653.9	2,661.1

* Excludes Human Nutrition Centers

V. COORDINATION AND ADVISORY MECHANISMS

A. Coordination Within the Federal Sector

1. Interagency Committee on Human Nutrition Research (ICHNR)

The ICHNR continued to coordinate human nutrition research activities at the Federal level during FY 1988. During the year, agency research reports were presented by the Agricultural Research Service, Department of Defense, National Science Foundation, Veterans Administration, and Department of Commerce representatives.

Plans were made for holding the fourth Conference for Federally Supported Human Nutrition Research Units and Centers on the NIH campus on February 15-16. The two topics to be covered are (1) function of nutrients and (2) nutrient interactions and toxicities.

This Interagency Committee also helped to form the new Interagency Committee on Nutrition Monitoring (ICHNM), and expects to coordinate activities with ICNM as well as alternate meeting dates, since there is some overlap in membership.

2. Interagency Committee on Nutrition Monitoring

This Committee was established in recognition of the need for strong, sustained and coordinated Federal efforts to monitor the nutritional status of the American people. Its purpose is to increase overall effectiveness and productivity of nutrition monitoring efforts by working to achieve the goals in the 1987 Operational Plan for the National Nutrition Monitoring Plan. Co-chairs are the Assistant Secretary for Food and Consumer Service (USDA) and Assistant Secretary for Health (DHHS). Membership includes the Department of Defense, Veterans Administration, Agency for International Development, Census Bureau, Bureau of Labor Statistics, as well as the several agencies within USDA and DHHS that conduct nutrition monitoring activities. One of the first tasks of the committee has been to develop a working paper on nutrition monitoring research priority areas.

3. USDA/DHHS Cooperation in Nutrition Monitoring

The HNIS/USDA and the National Center for Health Statistics (NCHS), DHHS, are continuing their joint planning and collaboration in conducting the USDA Nationwide Food Consumption Survey and the NCHS National Health and Nutrition Examination Survey, the core surveys of the National Nutrition Monitoring Systems. Regular interagency working group meetings are held to coordinate survey planning and development of compatible systems. This cooperation has resulted in increased areas of comparability in survey design and questions and use of similar nutrient data bases for both surveys to assess dietary intakes. This collaboration, as well as the joint publication of the Dietary Guidelines for Americans, is coordinated by the Assistant Secretaries for Health in DHHS and for Food and Consumer Services in USDA.

4. Second Report to Congress from the National Nutrition Monitoring System

This report, to be submitted in 1989, has been initiated. A USDA/DHHS Joint Project Steering Committee has defined the content of the report to include an update on the dietary and nutritional status of the U.S. population based on data from the NNMS produced or released since the 1986 report and an indepth integrative analysis of two specific topics--nutritional factors in cardiovascular disease and assessment of iron nutriture. The scientific basis and review for the report is being prepared under a USDA/DHHS contract with the Life Sciences Research Office of the Federation of American Societies of Experimental Biology (FASEB). FASEB selected a nine-member expert panel on nutrition monitoring of persons outside the government from a variety of disciplines including public health, epidemiology, nutrition, agriculture economics, behavior science, and statistics to develop the scientific basis and review.

5. USDA and DHHS Cooperation on Diet-Health Knowledge Survey

Beginning with the CSFII in 1989, a follow-up survey for respondents will be conducted to assess their knowledge, attitudes, and perceptions concerning diet/health issues. HNIS, FSIS, and DHHS' FDA are working collaboratively in planning and designing the survey.

6. DHHS National Health Objectives for the Year 2000

The working groups have been formed to develop National Health Objectives for the Year 2000 and to prepare for evaluation of progress toward them. USDA is represented on the Nutrition Objectives Working Group in order to promote uniformity between the Departments.

7. USDA-Food and Nutrition Service/Centers for Disease Control (CDC) Interagency Agreement Regarding Smoking Cessation in Pregnancy

During the project demonstration phase, CDC will develop, field test, and evaluate a package of smoking cessation and maintain interventions in collaboration with three States, and in consultation with FNS. The intervention will be provided in both prenatal clinic and WIC settings in the States of Missouri, Colorado, and Maryland. The agreement, which was signed in FY 1986, will remain in effect through FY 1989. In addition, this agreement will expand the capabilities of the CDC Patient Flow Analysis System by promoting development and dissemination of WIC compatible patient flow analysis simulation software for microcomputers.

8. Memorandum of Understanding (MOU) Between Extension Service and Food and Drug Administration

An MOU has been prepared which commits Extension and FDA to coordinate and communicate on matters relating to developing, exchanging, and sharing educational materials, information pieces, and other major agency activities in the areas of food safety, nutrition, and veterinary medicine.

9. Joint Nutrient Data Base Committee

A joint HNIS/NCHS Nutrient Data Base Committee was formed and meets regularly to ensure continued development of compatible systems for handling and coding nutrient data for dietary intake surveys.

10. National Cholesterol Education Program

The Deputy Assistant Secretary for Food and Consumer Services served as USDA's liaison representative to the National Cholesterol Education Program (NCEP) Coordinating Committee. In this role the Committee is kept informed of USDA research results from food consumption surveys regarding dietary status and activities that are supportive of the Dietary Guidelines for Americans. HNIS exhibited at the First National Cholesterol Conference sponsored by the NCEP promoting USDA's system of Nationwide Food Consumption Surveys and Dietary Guidelines for Americans, and presenting USDA's Practicality Assessment System.

11. Users of National Nutrient Data Base

HNIS and NCL sponsored a meeting of all Federal users of National Nutrient Data Bank to discuss how priorities are established for research projects in food composition analysis and to solicit user input and recommendations. Representatives from DHHS' NCHS, Food and Drug Administration, National Heart, Lung and Blood Institute, National Cancer Institute, and National Institute on Aging, and USDA's FSIS attended. There was mutual agreement that research emphasis should continue in two priority areas--food components believed to be important to health promotion and disease prevention, and research to improve analytical basis of particular nutrients in foods known to be important sources in the diet. Establishing priorities for future needs in food composition analysis is particularly important for those food components for which data are limited, because the process from beginning research to publication of composition data for the food supply is at least 5 years or longer depending upon the analytical methodology.

B. Coordination Within USDA

1. Subcommittee for Human Nutrition

The Subcommittee for Human Nutrition of the Department's Research and Education Committee served as the mechanism for coordination of human nutrition activities across USDA. It held regularly scheduled monthly meetings of representatives of those agencies involved and liaison members from DHHS, NIH, and industry groups. The Subcommittee serves as the Department's mechanism for routine exchange of current information about nutrition activities and for evaluating needs and making recommendations on human nutrition issues as appropriate. It also serves as the vehicle for the implementation of cooperative program activities. This report, for example, was prepared through the Subcommittee.

2. Dietary Guidance Working Group

The Dietary Guidance Working Group, formed under the Subcommittee for Human Nutrition in 1986, continues to review all publications, including prospectuses and publication drafts, presenting dietary guidance information. The review process is thorough and timely for ensuring that guidance conforms to the Dietary Guidelines and is consistent and supportive across USDA agencies and the Federal Government. The group composed of representatives from nine USDA agencies and a DHHS liaison, also serves as a means of communication among nutrition education specialists in the USDA agencies that provide guidance to their respective clientele.

3. Human Nutrition Subcommittee of the Experiment Stations Committee on Programs and Policy (ESCOP)

The purpose of this subcommittee is to identify human nutrition research needs and any policy issues which may relate to these needs (i.e. training, equipment, available resources) and to make recommendations to ESCOP. The subcommittee also serves an important role in communication with related groups, and has liaison members meet with it from CSRS, HNIS, ARS, and other agencies.

4. Cooperative Regional Research Projects (CSRS)

The Cooperative State Research Service (CSRS) administers and funds cooperative human nutrition research involving land grant institutions, and 1890 colleges and universities. These are regional in nature and may involve collaboration with ARS scientists. The presently organized cooperative regional research projects are described:

- o Western Regional Research Project (W-143) - Nutrient Bioavailability--A Key to Human Nutrition

Our understanding of the dietary factors that affect the digestion and absorption of available form of nutrients, especially vitamins and minerals, is limited. Since some of the nutrients (iron, pyridoxine, calcium, folacin) most affected appear to be marginal or low in diets of certain population subgroups, data on bioavailability becomes of critical importance in establishing sound dietary requirements as well as appraising dietary adequacy. This project involves nine universities and the Western Human Nutrition Research Center.

- o Northeast Cooperative Regional Research Project (NE-147)--
Improving Sensitivity of Methods to Assess Nutrient Intake
and Predict Nutritional Risk

Dietary intake data are a critical link in the chain of measurements needed to evaluate and monitor nutritional status and to identify ways to improve diets. Individual assessment is a basic component of programs designed to initiate and monitor changes in food intake and food habits. This study involves eight institutions with a focus on ways to reduce errors in collection of dietary intake data.

- o North Central Cooperative Regional Research Project (NC-173)--
"Communication Strategies to Improve Nutritional Practices of
Adolescents"

The goal of this project is to design communication strategies which are effective and feasible for motivating adolescents to make optimal dietary choices. Nutrient orientation and problems of adolescents will be considered, such as their interest in sports and athletics, high incidence of pregnancy, common occurrence of iron deficiency anemia, concern with body image, high incidence of obesity, and occurrence of anorexia nervosa.

- o Western Cooperative Regional Research Project (W-153)--
Economic and Behavioral Factors Associated with Food
Supplement Usage

The objectives of this project are (1) to identify attitudes and economic factors which result in the use of food supplements and (2) to determine if a relationship exists between health attitudes and intentions and actual vitamin/mineral supplementation behavior.

- o North Central Cooperative Regional Research Project
(N-167)--Health Maintenance Aspects of Dietary Recommendations
Designed to Modify Lipid Metabolism

The objectives of this project are (1) to determine the effects of dietary omega 3/omega-6/omega-9 fatty acid ratios on physiological factors in humans and experimental animals, (2) to evaluate the effects of caloric intake, expenditure distribution, and dilution on serum lipid levels, metabolism, blood response, and body composition and (3) to assess the effects of varying levels of dietary minerals on blood lipoproteins. This study involves collaboration between seven different universities.

5. FNS and HNIS Cooperation on Standards

FNS and HNIS cooperate in the development of certain food assistance program standards, such as the thrifty food plan for establishing benefits in the Food Stamp Program and meal patterns for measuring compliance in the National School Lunch Program. HNIS-generated data bases on food composition and food consumption and prices are used in developing the standards.

6. HNIS and ERS Cooperation on Food Supply Data

ERS and HNIS cooperate in estimating and publishing information on trends in the nutrient content of U.S. food supplies.

7. HNIS and ES Cooperation on Nutrition Education Information Needs

A Memorandum of Understanding between ES and HNIS has expanded and clarified the intentions of the two agencies to work together in achieving their common goals in nutrition education. A Cooperative Extension System/Extension Service/HNIS Consulting Group was formed to advise HNIS staff concerning their future nutrition education needs. This Group meets quarterly through teleconferences or face-to-face meetings to facilitate communications. One of the major projects conducted jointly by HNIS and ES was development of a dietary analysis software package for the personal computer. ES and HNIS are cooperating in evaluating use of the software in a variety of Extension system programs.

C. Coordination with the Private Sector

1. Committee on Dietary Guidelines Implementation

The Food and Nutrition Board of the National Academy of Sciences initiated a study on implementing dietary guidelines. The two major goals of the study are to propose detailed strategies and options for the implementation of dietary guidelines by the various groups and organizations that have issued them, and to examine potential benefits and costs of implementation. At the request of the Committee, USDA provided an extensive summary of our multi-faceted program to promote and implement the Dietary Guidelines for Americans. An HNIS staff person is serving as a resource person to the Committee regarding USDA's Practicality Assessment System.

2. Committee on Nutritional Status During Pregnancy and Lactation

This National Academy of Sciences Committee is evaluating and documenting the current scientific evidence and will propose recommendations pertaining to dietary intake and nutritional status during pregnancy and lactation. USDA is serving as a liaison member for this committee. HNIS has provided the Committee with information about USDA food consumption survey data relative to pregnant and lactating women.

3. ARS Nutrition Composition Laboratory and HNIS Nutrient Data Research

There continues to be a very close working relationship and interaction between the ARS Nutrition Composition Laboratory (NCL) and the HNIS Nutrient Data Research Branch in planning and conducting food composition studies and in compiling and documenting results. NCL distributes and evaluates test sample analyses as part of HNIS contractor selection process for food composition analyses. NCL and HNIS are part of an international collaborative research study evaluating methods of dietary fiber analysis being conducted in laboratories in the United Kingdom, Canada, and the United States.

4. Food and Nutrition Information Center

The Food and Nutrition Information Center is currently working with the American Dietetic Association to coordinate and prevent duplication of services planned through the ADA's Center for Nutrition and Dietetics.

D. Advisory Groups

1. Human Nutrition Board of Scientific Counselors (HNBSC)

a. Resolution Regarding USDA Competitive Research Grants in Human Nutrition (April 8, 1988)

"The Advisory Board wishes to reaffirm the importance of the Competitive Grants Program in Human Nutrition and is concerned about the inadequate level of funding currently available. Our concern is based on the following:

1. This particular program fills a unique role in the nutrition research community by focusing on basic research in nutrient requirements, molecular function of nutrients, and nutrient interaction. The data generated by this program to date substantially supplements the specific health aspects of nutrients, enhancing the entire research program in agriculture by providing the scientific basis for food and commodity development, e.g., the nutrient applicability of low-fat meats, high fiber products, or altered mineral content of fruits and vegetables.
2. By design, the competitive nature and peer review of applications assures that only the best would be funded. However, over the past 10 years funding has decreased both in absolute dollars and as a percent of the competitive grants program (FY 1979 representing \$5 million of \$15 million versus FY 1988 \$2.4 million/\$44 million) even as the importance of nutrition and nutrient interactions in human health become more evident.
3. In terms of the public interest in nutrition and long-term quality of life (vis a vis nutritional status and health benefits) and in terms of public concern about rising medical costs, this is a key program that cannot be neglected.
4. The Human Nutrition Board of Scientific Counselors invites the U.S. Department of Agriculture and the Experiment Station Committee on Organization and Policy to join the nutrition research community in convincing the Administration and Congress that funding must be increased for this research program.

Therefore, the Board unanimously recommends that USDA take appropriate action to assure funding in FY 1990 budget of \$4 million and that recommendation for future years be based on funding necessary for the top 25 percent of the approved applications."

b. Report on Nutrition Education

The recommendations included in the FY 1987 Report to Congress were finalized as follows:

"The American agricultural system is being buffeted by changes in the concept of healthful foods. The objective of profitable production of food for domestic and foreign consumption is being influenced by the health concerns of consumers. These consumer concerns represent a major shift in emphasis on the value of foods. They warrant reevaluation of the U.S. Department of Agriculture's role in nutrition education.

Traditionally, the Cooperative Extension Service has been a primary source of nutrition information. This role has been eroded by limited resources and the reallocation of resources toward research and extension work involving the efficiency of food production. The deemphasis on efforts to improve consumer understanding of nutrition has exacerbated tension between consumers and producers.

There is a critical need for greater nutrition expertise at all levels within the Extension Service. This is due in part to the system of funding, in which counties and states contribute funds and determine priorities, which limits the ability to develop a central nutrition-related focus. At the same time, Extension personnel are being asked to answer increasingly complex nutrition-related questions, requiring sophisticated training and materials for satisfactory responses. Within the Extension Service itself, limited personnel and resources are available to give national leadership in nutrition education. Since the Dietary Guidelines and related materials do not address all the pertinent issues, periodic training to keep nutrition educators updated concerning new developments is critical.

The increased public concern with food and nutrition also means that the Extension Service must address a wide, diverse audience, one far different from its traditional rural audience. The Task Group encourages greater efforts to educate people of all ages and socioeconomic groups living in urban and rural areas. Groups known to be at special risk may warrant special attention.

Many consumers are concerned with weight management, dietary intake of specific nutrients, and possible relationships between food and degenerative diseases. Animal products are the focus of much of the concern, as is manifested by the fact that the consumption of low-fat milk has increased markedly and whole milk has decreased and by the attempts of producers and processors to reduce the fat content of meat.

Also, advertising and health claims widely disseminated via the mass media influence consumers' food choices. Some of this information may be incomplete and misleading.

The Nutrition Education Task Group of the USDA Human Nutrition Board of Scientific Counselors believes strongly that the U.S. Department of Agriculture has a responsibility to provide accurate, clear, concise, and usable nutrition information. It is with some sense of urgency that we recommend that the Department bolster its commitment to nutrition education, and emphasize the dissemination of accurate information concerning the relationship of food to health.

It is extremely important that the messages of Federal and State nutrition education programs be accurate and consistent. The public is confused when they receive conflicting information. The confusion of information and misinformation makes it difficult to predict what the consumer will decide to buy. In this regard, we commend the Department for its efforts to date in increasing coordination among agencies concerned with nutrition education.

We believe that the Dietary Guidelines for Americans provide the basis for developing sound continuing nutrition education programs. The Extension Service and the Human Nutrition Information Service should coordinate their efforts to effectively disseminate clear, concise, and useful nutrition

information. The effectiveness of the nutrition education program also would be enhanced by employing more qualified nutrition experts at the Federal and State levels, and by closer relationships between Extension personnel and researchers in land grant universities. The credibility of the Extension Service's nutrition education efforts depends on hiring competent personnel.

The limited resources available for nutrition education require that, as noted in "Food and Nutrition: The Link Between Health and Agriculture, Directions for the Cooperative Extension System"^{1/}, some universities concentrate on certain aspects of nutrition, e.g., the evaluation of new and unusual trends, nutrition concerns of the elderly, the relationships between nutrition and aging, nutrition and pregnancy, infant feeding practices, diet-related disorders, nutrition and mental and physical performance, etc. Development of these as centers of excellence would improve the dissemination of information and also increase opportunities to educate M.S. and Ph.D. students in nutrition, thus increasing the number of qualified nutrition educators. These centers would be an important national resource that could be funded in part through Federal grants or by redistributing formula funds.

Recommendations

Recommendations 3, 4, and 5 concern the Cooperative Extension Service and are related to the recommendations in the above "Food and Nutrition" report and we recommend that they be implemented.

1. The nutrition education programs of the Department should provide consistent, accurate, clear, concise, and useful information to help consumers make informed food choices. This information will also assist the food industry.
2. The U.S. Dietary Guidelines should be used as the basis for developing all nutrition education programs conducted by the Department. The Department should, whenever necessary, target this information to selected groups. Coordination and communication between the Human Nutrition Information Service and Extension nutrition specialists should be continued.
3. The educational materials developed by the Human Nutrition Information Service should meet the needs of the Extension Service. The organizational structure makes this difficult, but the Committee believes such coordinated effort is absolutely essential.
4. Nutrition education specialists in Extension should be integrated as faculty members in academic departments at land grant institutions. This will facilitate the dissemination of information and enhance specialists' expertise.
5. The Department should increase nutrition expertise at the Federal level to provide appropriate leadership for fostering and enhancing federal coordination with state and county programs.

^{1/} Food and Nutrition: The Link Between Health and Agriculture--Directions for the Cooperative Extension System," produced cooperatively by Extension Committee on Organization and Policy; Extension Service, USDA; and Cornell Cooperative Extension."

6. Centers of Excellence in Extension nutrition should be implemented within institutions that have strong nutrition programs. These centers should also provide opportunities for fellowships in nutrition education. The Task Group recognizes that implementation of these recommendations may require retention of more funds at the Federal level.

Members of Nutrition Education Task Group: R. Gaurth Hansen, Chairperson, Utah State University; Patricia Swan, University of Minnesota; Alfred Harper, University of Wisconsin; Arlette Rasmussen, University of Delaware; David Hurt, Quaker Oats Company; G. Richard Jansen, Colorado State University.

2. FNS' Advisory Councils

The Food and Nutrition Service (FNS) has two advisory councils, the National Advisory Council on Child Nutrition (NACCN) and the National Advisory Council on Maternal, Infant and Fetal Nutrition (NACMIFN). They meet biennially to determine how program administration and operations can be improved. Descriptions of the councils and their activities were included in the 1986 USDA Human Nutrition Research Report to Congress. A NACCN meeting was held in May 1988. Among the program recommendations made was an endorsement of USDA's continued efforts to provide guidance on the implementation of the dietary guidelines in the Child Nutrition Programs.

3. Dietary Guidelines Advisory Committee

USDA and DHHS are re-establishing a Federal Dietary Guidelines Advisory Committee. HNIS is the lead agency within USDA. Suggestions for advisory committee members have been requested from national scientific groups as well as through a Federal Register Notice. The committee will review recent scientific evidence on diet/health relationships and determine if revision is necessary. If the committee deems revision is needed, they will recommend specific changes to the Secretaries of USDA and DHHS. These recommendations will be used by the two Departments to prepare a third edition of the Guidelines to be issued in the early 1990's.





